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TRANSACTIONS

OF THE

COLLEGE OF PHYSICIANS

OF

PHILADELPHIA

THIRD SERIES

VOLUME THE FORTY-SIXTH

PHILADELPHIA
PRINTED FOR THE COLLEGE
1924

NOTICE

The present volume of TRANSACTIONS contains the papers read before the College from January, 1924, to December, 1924, inclusive.

The Committee of Publication thinks it proper to say that the College holds itself in no way responsible for the statements, reasonings, or opinions set forth in the various papers published in its TRANSACTIONS.

EDITED BY

WALTER G. ELMER, M.D.

"This volume is published in part by the income from the Francis Houston Wyeth Fund."

DORNAN, PRINTER

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1805	WILLIAM SHIPPEN
1809	ADAM KUHN
1818	THOMAS PARKE
1835	THOMAS C. JAMES[1]
1835	THOMAS T. HEWSON
1848	GEORGE B. WOOD
1879	W. S. W. RUSCHENBERGER
1883	ALFRED STILLÉ
1884	SAMUEL LEWIS[2]
1884	J. M. DA COSTA
1886	S. WEIR MITCHELL
1889	D. HAYES AGNEW
1892	S. WEIR MITCHELL
1895	J. M. DA COSTA
1898	JOHN ASHHURST, JR.
1900	W. W. KEEN
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1904	ARTHUR V. MEIGS
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1910	GEORGE E. DE SCHWEINITZ
1913	JAMES CORNELIUS WILSON
1916	RICHARD H. HARTE
1919	WILLIAM J. TAYLOR
1922	THOMAS R. NEILSON

[1] Died four months after his election.
[2] Resigned on account of ill-health.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

1924

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FELLOWS

OF THE

COLLEGE OF PHYSICIANS OF PHILADELPHIA

DECEMBER, 1924

* Non-resident Fellows. † Fellows who have commuted dues. ‡ Deceased.

ELECTED

1892. Abbott, Alexander Crever, M.D., Sc.D., Dr. P.H., Professor of Hygiene and Bacteriology and Director of the School of Hygiene and Public Health, University of Pennsylvania. 4016 Pine St.

1921. Addison, William H. F., A.B., M.D., Professor of Normal Histology and Embryology in the University of Pennsylvania. Medical Laboratories, University of Pennsylvania.

1905. Adler, Lewis H., Jr., M.D., Formerly Professor of Proctology in the Graduate School of Medicine, University of Pennsylvania; formerly Prosector to the Professor of Anatomy in the University of Pennsylvania; Consulting Surgeon to the Charity Hospital. 313 S. Seventeenth St.

1914. Aiken, Thomas Gerald, M.D., Physician-in-Chief to the Chester County Hospital, West Chester, Pa.; Pathologist to the Country Branch of the Rush Hospital for Tuberculosis. Berwyn, Pa.

1913. Alexander, Emory G., M.D., Surgeon to St. Christopher's Hospital for Children; Associate Surgeon to the Episcopal Hospital; Clinical Professor of Surgery in the Woman's Medical College of Pennsylvania; Demonstrator of Fracture Dressings in the Jefferson Medical College, and Assistant Surgeon to the Kensington Hospital for Women. 1701 Spruce St.

ELECTED

1906. Allen, Francis Olcott, Jr., A.B., M.D., Surgeon to the Presbyterian Hospital; Associate Surgeon to the Pennsylvania Hospital. 2216 Walnut St.

1896. Allyn, Herman B., A.B., M.D., Physician to the Philadelphia General Hospital. 3910 Chestnut St.

1888. Anders, James M., M.D., L.L.D., Professor of Medicine and Clinical Medicine in the Medico-Chirurgical College; Officer de l'Instruction Publique. 250 S. Seventeenth St.

1905. Anspach, Brooke M., M.D., Professor of Gynecology in the Jefferson Medical College; Attending Gynecologist, Jefferson Hospital; Gynecologist to the Stetson Hospital; Attending Gynecologist to the Bryn Mawr Hospital. 1827 Spruce St.

1905. Appleman, Leighton F., M.D., Demonstrator of Pharmacy and Materia Medica, and Instructor in Therapeutics in the Jefferson Medical College; Associate Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Attending Surgeon to the Wills Eye Hospital; Ophthalmologist to the Frederick Douglass Memorial Hospital and to the Burd School. 308 S. Sixteenth St.

1922. Arnett, John Hancock, A.B., M.D., Instructor in Medicine, Medical School, University of Pennsylvania; Assistant in Medicine and Students' Physician, University Hospital. 269 S. Twenty-first St.

1906. Ashhurst, Astley Paston Cooper, A.B., M.D., Professor of Clinical Surgery, University of Pennsylvania; Surgeon to the Episcopal Hospital and to the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases. N. E. Cor. Sixteenth and Spruce Sts.

1893. Ashton, Thomas G., M.D., Physician to the Philadelphia General Hospital. Wynnewood, Pa.

1920. Astley, George Mason, M.D., Assistant Surgeon, Samaritan Hospital. 5317 Master St.

1914. Austin, J. Harold, B.S. (Univ. of Penna.), M.D., Professor of Research Medicine, University of Pennsylvania. Pepper Laboratory, University of Pennsylvania.

1906. Babbitt, James A., A.B. (Yale), A.M. (Haverford), M.D., Assistant Professor of Otology, University of Pennsylvania; Associate Professor of Oto-Laryngology, Graduate School of Medicine, University of Pennsylvania; Assistant Laryn-

ELECTED

gologist and Aurist, Lankenau Hospital; Laryngologist, Mary Drexel Children's Hospital. 2117 Chestnut St.

1910. Baer, Benjamin F., Jr., B.S., M.D., Associate Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Assistant Ophthalmologist, University Hospital; Consultant Ophthalmologist, Philadelphia Lying-in Charity Hospital. 1927 Spruce St.

†1892. Baker, George Fales, B.S., M.D. 1818 Spruce St.

1911. Baldwin, James Harvey, A.B., M.D., Surgeon to the Methodist Hospital. 1426 Pine St.

1889. Baldy, John Montgomery, M.D., Surgeon to the Gynecean Hospital; Consulting Surgeon to the Jewish and the Frederick Douglass Memorial Hospitals. Devon, Pa.

1916. Balentine, Percival L., M.D., Assistant Surgeon, Wills Eye Hospital; Demonstrator of Ophthalmic Surgery in the Philadelphia Polyclinic. 302 Weightman Building, 1524 Chestnut St.

1898. Balliet, Tilghman M., A.M., M.D., Professor of Therapeutics at Dartmouth College, Hanover, N. H.; Physician to the Old Man's Home. 3920 Sansom St.

1911. Barnard, Everett P., M.D., Obstetrician to the Maternity Hospital; Assistant Instructor in Obstetrics in the University of Pennsylvania. 245 S. Eighteenth St.

1924. Bartle, Henry J., B.S., M.D., Clinical Assistant, Out-patient Medical Department, Lankenau Hospital; Clinical Assistant, Department for Diseases of the Stomach and Bowels, Jefferson Medical College and Hospital. 2018 Chestnut St.

1921. Bauer, Edward L., M.D., Consultant Pediatrist, Germantown Hospital; Visiting Physician, Philadelphia Hospital for Contagious Diseases; Assistant Visiting Physician, Children's Hospital of the Mary J. Drexel Home. 6112 Germantown Ave.

1883. Baum, Charles, A.M., M.D., Ph.D. 1828 Wallace St.

1922. Bazett, Henry Cuthbert, M.A., M.D. (Oxon.), F.R.C.S. (England), Professor of Physiology, University of Pennsylvania. Bryn Mawr, Pa.

1908. Beardsley, Edward J. G., M.D., L.R.C.P. (Lond.), Associate Professor of Medicine in the Jefferson Medical College; Chief Clinical Assistant in the Out-patient Medical Department of the Jefferson Medical College Hospital; Assistant Physician to the Jefferson Hospital. 258 S. Sixteenth St.

ELECTED

*1916. Bell, William Hemphill, M.D., Captain, Medical Corps, U. S. Navy, Medical Officer of the Academy (Senior Medical Officer), U. S. Naval Academy, Annapolis, Maryland.

1923. Bergey, David H., A.M., M.D., B.S., Dr.P.H., Assistant Professor of Hygiene and Bacteriology, University of Pennsylvania. 206 S. Fifty-third St.

‡1896. Beyea, Henry D., M.D. Ware Neck, Va.

*1903. Biggs, Montgomery H., M.D., Surgeon to the Rutherford Hospital; Chief Surgeon of the Carolina, Churchfield and Ohio Railway. Rutherfordton, N. C.

1918. Billings, Arthur E., M.D., Clinical Assistant in Surgery, Dept. B, Jefferson Medical College; Surgeon to Pennsylvania and Bryn Mawr Hospitals. 2020 Spruce St.

1917. Birdsall, Joseph C., A.B., A.M., M.D., Urologist, Polyclinic Section of the Medico-Chirurgical College and Hospital, Graduate School of Medicine, University of Pennsylvania; Assistant in Genito-urinary Dispensary, Presbyterian Hospital; Instructor in Surgery, University of Pennsylvania. 4610 Spruce St.

1908. Bland, Pascal Brooke, M.D., Chief Clinical Assistant in the Gynecological Department of the Jefferson Medical College Hospital; Instructor in Gynecology in the Jefferson Medical College; Gynecologist to St. Joseph's Hospital; Assistant Gynecologist to the Philadelphia General Hospital. 1621 Spruce St.

1917. Block, Frank B., A.B., M.D., Surgeon to the Jewish Hospital; Instructor in Gynecology in the University of Pennsylvania. 2035 Chestnut St.

1894. Bochroch, Max H., M.D., Neurologist to the St. Joseph's and Jewish Hospitals; Physician to the Psychopathic Wards of the Philadelphia General Hospital. 1539 Pine St.

1896. Boger, John A., A.M., M.D., Surgeon to St. Mary's Hospital; Surgeon to the Stetson Hospital; Surgeon to the Dispensary of the Episcopal Hospital. 2213 N. Broad St.

1923. Bond, Earl D., A.B., M.D., Physician-in-Chief, Pennsylvania Hospital, Department for Mental and Nervous Diseases; Professor of Psychiatry, Graduate School of Medicine, Univeristy of Pennsylvania. Bryn Mawr, Pa.

1911. Bonney, Charles W., A.B., M.D., Associate in Topographic and Applied Anatomy in the Jefferson Medical College. 1117 Spruce St.

ELECTED

1924. Boon, David J., M.D., Opthalmologist, Memorial Hospital and Philadelphia Hospital for Contagious Diseases; Assistant Ophthalmic Surgeon, Episcopal Hospital. 1532 N. Fifteenth Street.

1921. Borzell, Francis Frank, M.D., Roentgenologist, Frankford Hospital; Chief Clinical Assistant, Roentgen Department, Jefferson Medical College; X-Ray Consultant, State Hospital for the Insane, Norristown, Pa. 4910 Frankford Ave.

1913. Boston, L. Napoleon, A.M., M.D., Professor of Physical Diagnosis in the Medico-Chirurgical College; Physician to the Philadelphia General Hospital; Pathologist to the Frankford Hospital. 2024 Chestnut St.

1919. Bowen, David Ralph, M.D., Radiologist to the Pennsylvania Hospital; Assistant Professor in Radiology, Graduate School of Medicine, University of Pennsylvania. 82 W. Lacrosse Ave., Lansdowne, Pa.

1923. Bower, John O., M.D. 2008 Walnut St.

1891. Boyd, George M., M.D., Professor of Obstetrics, Graduate School of Medicine, University of Pennsylvania; Consultant to the Philadelphia Lying-in Charity; Obstetrician and Gynecologist to the Medico-Chirurgical Hospital. 1909 Spruce St.

1907. Boyer, Henry Percival, M.D., Neurologist to the Stetson Hospital; Physician to the Philadelphia Home for Incurables; Assistant Physican to the Orthopædic Hospital and Infirmary for Nervous Diseases. 4602 Baltimore Ave.

1907. Bradley, William N., Ph.G., M.D., Visiting Pediatrist to Howard Hospital; Visiting Pediatrist to Philadelphia General Hospital; Associate in Pediatrics, School of Medicine, University of Pennsylvania; Associate in Pediatrics, Graduate School of Medicine, University of Pennsylvania. 1725 Pine St.

1923. Braisted, William C., M.D., Ph.B., LL.D., D.Sc., F.R.C.S. (Edin.), Surgeon-General, U. S. Navy, retired; President, Philadelphia College of Pharmacy and Science. West Chester, Pa.

1921. Bransfield, John W., M.D., Clinical Professor of Surgery, Woman's Medical College; Visiting Surgeon to St. Agnes, St. Vincent's and Woman's College Hospitals. 2025 Walnut Street.

ELECTED

1903. Branson, Thomas F., M.D., Attending Physician to the Bryn Mawr Hospital. Rosemont, Pa.

1891. Brinton, Lewis, M.D., Physician-in-Chief to the American Hospital for Diseases of the Stomach. 1301 Medical Arts Bldg., Sixteenth and Walnut Sts.

1900. Brinton, Ward, A.M., M.D., Clinical Professor of Medicine, Woman's Medical College of Pennsylvania; Instructor in Medicine, University of Pennsylvania; Chief of Division of Tuberculosis, Department of Public Health of Philadelphia; Visiting Physician, Department for Tuberculosis, Philadelphia General Hospital. 1423 Spruce St.

1917. Bromer, Ralph S., A.B. (Yale), M.D., Roentgenologist to the Episcopal and the Orthopædic Hospitals. 504 W. Mt. Airy Ave.

‡1907. Brooks, Macy, A.B. (Princeton), M.D., Care Morgan, Harjes & Co., Paris, France.

1919. Brown, H. MacVeagh, M.D., Associate Physician, Presbyterian Hospital. 4608 Baltimore Ave.

1919. Brown, Henry P., Jr., M.D., Assistant Surgeon, Presbyterian and Pennsylvania Hospitals; Dispensary Surgeon, Children's Hospital. 2134 Spruce St.

1916. Brown, Samuel Horton, M.D. 1901 Mt. Vernon St.

1887. Brubaker, Albert P., A.M., M.D., Professor of Physiology and Medical Jurisprudence in the Jefferson Medical College. 3426 Powelton Ave.

1916. Buckley, Albert Coulson, M.D., Medical Superintendent, Friends' Hospital, Frankford; Associate Professor of Psychiatry, Graduate School of Medicine, University of Pennsylvania. Frankford, Phila.

1906. Burns, Stillwell C., M.D., Associate Professor of Surgery in the Graduate School of Medicine, University of Pennsylvania. 1925 Spring Garden St.

1892. Burr, Charles W., M.D., Professor of Mental Diseases in the University of Pennsylvania; Neurologist to the Philadelphia General Hospital. 1918 Spruce St.

1906. Butler, Ralph, M.D., Professor of Diseases of the Nose and Throat in the Philadelphia Polyclinic and the College for Graduates in Medicine; Chief of the Dispensary for Diseases of the Ear at the University Hospital; Assistant Professor of Otology in the University of Pennsylvania; Laryngologist and Aurist to the Lankenau Hospital. 2007 Chestnut St.

ELECTED

*1908. Cadbury, William W., A.M., M.D., Canton Christian College, Canton, China.

†1907. Cadwalader, Williams B., M.D., Assistant Professor of Neurology, School of Medicine, University of Pennsylvania; Neurologist to the Presbyterian Hospital; Consulting Neurologist to the Bryn Mawr Hospital. 1206 Medical Arts Building.

1905. Carmany, Harry S., M.D., Surgeon to Memorial Hospital, Roxborough; Associate Surgeon of the Episcopal Hospital; Surgeon to the Dispensary of the Episcopal Hospital. 366 Green Lane, Roxborough.

1924. Carncross, Horace, M.D., 1003 Spruce St.

1910. Carnett, John Berton, M.D., Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Associate in Surgery, Medical Department, University of Pennsylvania; Surgeon to Philadelphia General Hospital; Chief Surgeon to the American Stomach Hospital. 2012 Spruce St.

1905. Carpenter, Herbert B., M.D. 1805 Spruce St.

1895. Carpenter, John T., M.D., Attending Ophthalmologist to the Bryn Mawr Hospital. 2030 Chestnut St.

1917. Carson, John B., M.D., Physician to Episcopal Hospital; Assistant Physician, Pennsylvania Hospital. 1802 Pine Street.

1922. Case, Eugene A., M.D., Associate Professor of Pathology, University of Pennsylvania; Assistant Pathologist, Philadelphia General Hospital. Lansdowne, Pa.

1900. Chance, Burton, M.D., Attending Surgeon to the Wills Eye Hospital; Consulting Ophthalmologist Eastern Pennsylvania Institution for the Feeble-minded and Epileptics; Ophthalmic Surgeon to the Pennsylvania Railroad Company. 1305 Spruce St.

1897. Cheston, Radcliffe, M.D., Visiting Physician to the Chestnut Hill Hospital; Consulting Physician to the Germantown Hospital and to the Pennsylvania Institution for the Deaf and Dumb. Chestnut Hill.

1903. Chrystie, Walter, M.D. One of the Senior Physicians to Bryn Mawr Hospital. Bryn Mawr, Pa.

1899. Clark, John G., M.D., Professor of Gynecology in the University of Pennsylvania; Gynecologist-in-Chief to the University Hospital. 2017 Walnut St.

ELECTED

1910. Cloud, J. Howard, M.D., Attending Physician to the Bryn Mawr Hospital. 11 W. Montgomery Ave., Ardmore, Pa.

1903. Coates, George Morrison, A.B., M.D., Professor of Otology, Graduate School of Medicine, University of Pennsylvania; Associate Surgeon, Ear, Throat and Nose, Pennsylvania Hospital; Consulting Laryngologist to the Philadelphia Orphanage and to the Sharon Hospital, Sharon, Conn. 1811 Spruce St.

1908. Codman, Charles A. E., M.D., Physician to the American Oncologic Hospital. 4116 Spruce St.

1922. Cohen, Leon Solis, A.B., M.D., Clinical Assistant of Roentgenology, Jefferson Medical College. 1923 Spruce St.

1907. Cohen, Myer Solis, A.B., M.D., Assistant Professor in Medicine, Graduate School of Medicine, University of Pennsylvania; Lecturer on Medical Jurisprudence, Woman's Medical College of Pennsylvania; Director of the Jules E. Mastbaum Research Laboratory of the Jewish Hospital; Pediatrist to the Jewish Hospital. 1833 Pine St.

1888. Cohen, Solomon Solis, M.D., Professor of Clinical Medicine in the Jefferson Medical College; Physician to the Jefferson Medical College Hospital, to the Philadelphia General Hospital, to the Jewish Hospital and to the Rush Hospital. 1906 Walnut St.

1920. Cole, Charles J., A.B., M.D., Visiting Physician, Philadelphia Hospital for Contagious Diseases; Assistant Pediatrist, Polyclinic Hospital; Physician to Out-patient Department, Mary Drexel Home; Assistant Physician to Out-patient Department, Children's Hospital, University Hospital. Elkins Park, Pa.

1898. Coles, Stricker, M.D. Bryn Mawr, Pa.

*1901. Coley, Thomas Luther, A.B., M.D., Major, Medical Corps, U. S. Army. *Care*, Department Surgeon, Manila, P. I.

1903. Coplin, W. M. L., M.D., Professor of Pathology in the Jefferson Medical College; Pathologist to and Director of the Laboratories of the Jefferson Medical College Hospital; Pathologist to the Philadelphia General Hospital and to the Friends' Asylum for the Insane, Frankford; Bacteriologist to the Pennsylvania State Board of Health. Albany Apartments, Atlantic City, N. J.

1912. Copp, Owen, A.B., M.D., Consultant for the Future Development of the Pennsylvania Hospital. 4401 Market St.

ELECTED

1911. Cornell, Walter Stewart, A.B., M.D., Director of Medical Inspection of Public Schools of the City of Philadelphia; Chief of Medical Staff of the House of Detention; Lecturer on Osteology in the University of Pennsylvania. 1919 Cherry St.

1914. Corson, Edward Foulke, M.D., Assistant Professor of Dermatology, Jefferson Medical College; Dermatologist, Children's Hospital of Philadelphia. 1927 Spruce St.

1907. Council, Malcolm S., M.D., Attending Physician to the Bryn Mawr Hospital; Attending Physician to the Cathcart Home at Devon. Bryn Mawr, Pa.

1924. Cowan, Alfred, M.D., Associate in Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Assistant Surgeon, Wills Hospital; Assistant Dispensary Surgeon, University Hospital; Assistant Instructor in Ophthalmology, School of Medicine, University of Pennsylvania. 2007 Pine Street.

1904. Craig, Frank A., M.D., Instructor in Medicine in the University of Pennsylvania; Visiting Physician to the Henry Phipps Institute, University of Pennsylvania; Visiting Physician to the White Haven Sanatorium; Tuberculosis Consultant to the Presbyterian Hospital. 2011 Pine Street.

1907. Crampton, George S., M.D., Attending Surgeon to the Eye Department of the Pennsylvania Hospital and the Philadelphia Hospital for Contagious Diseases; Assistant Surgeon to the Wills Hospital; Lecturer on Physiologic Optics in the Philadelphia Polyclinic and School for Graduates in Medicine; Ophthalmologist to the Philadelphia Orphanage. 1819 Walnut St.

1924. Crawford, Baxter Lindsey, M.D., Associate in Pathology, Jefferson Medical College; Chief of Laboratory Service, Jefferson Hospital; Assistant Pathologist, Philadelphia General Hospital. Jefferson Hospital, Tenth and Sansom Sts.

1920. Creighton, William J., B.A., M.D., Assistant Ophthalmic Surgeon, Germantown Hospital and Dispensary; Assistant Dispensary Surgeon, Department Ophthalmology, University Hospital; Instructor in Ophthalmology, University of Pennsylvania Medical School. 1905 Chestnut St.

1920. Cross, George Howard, M.D., Ophthalmologist to the Chester Hospital; Instructor in Ophthalmology, Graduate School of Medicine, University of Pennsylvania. Chester, Pa.

ELECTED

1917. Cross, Sumner H., A.B., M.D., Physician to the Abington Memorial Hospital, Abington, Pa. 412 York Road, Jenkintown, Pa.

1921. Crossan, Edward T., M.D., N. E. Cor. Sixteenth and Spruce Streets.

1924. Crowell, Bowman C., A.B., M.D., C.M., Professor of Pathology, Jefferson Medical College; Pathologist, Jefferson Hospital; Attending Pathologist, Philadelphia General Hospital. "The Gladstone."

1904. Cruice, John M., M.D., Physician to the Henry Phipps Institute of the University of Pennsylvania; Physician to the Medical Dispensary of St. Agnes' Hospital; Instructor in Medicine in the University of Pennsylvania. 2021 Pine St.

*1910. Cummins, W. Taylor, M.D., Pathologist to the Southern Pacific Hospital; Director of the Mary W. Harriman Research Laboratory, San Francisco, Cal.

1902. Currie, Charles A., M.D., Physician to the Germantown Hospital. West Walnut Lane, Germantown.

1896. Da Costa, John Chalmers, M.D., Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to the Philadelphia General and St. Joseph's Hospitals. 2045 Walnut St.

1887. Daland, Judson, M.D., Professor of Medicine, Graduate School of Medicine, University of Pennsylvania. 317 S. Eighteenth St.

1919. Davies, John R., Jr., M.D., Chief to the Out-patient Nose, Throat and Ear Department of the Pennsylvania, Bryn Mawr and Chestnut Hill Hospitals. 302 S. Nineteenth St.

1896. Davis, Charles N., M.D., Dermatologist to the Pennsylvania Hospital; Consulting Dermatologist to St. Agnes' Hospital; Assistant Physician to the Dispensary for Skin Diseases in the Howard Hospital. 1931 Spruce St.

1888. Davis, Edward P., A.M., M.D., Professor of Obstetrics in the Jefferson Medical College; Obstetrician to the Jefferson Hospital; Obstetrician and Gynecologist to the Philadelphia General Hospital; Consultant to the Preston Retreat. Racquet Club.

1916. Davis, Warren B., M.D., Rhinologist, Laryngologist, and Otologist, St. Agnes' Hospital; Instructor in Surgery, Jefferson Medical College; Instructor in Anatomy, Jefferson Medical College; Assistant Surgeon, Frankford Hospital. 135 S. Eighteenth St.

ELECTED

1900. Davisson, Alex. Heron, M.D. 4514 Springfield Ave.

1894. Deaver, Harry C., M.D., Professor of Surgery in the Woman's Medical College of Pennsylvania; Surgeon to the Episcopal Hospital and to the Children's Hospital of the Mary J. Drexel Home; Surgeon-in-Chief to the Kensington Hospital for Women. 1701 Spruce St.

1887. Deaver, John B., M.D., D.Sc., LL.D., John Rea Barton Professor of Surgery, University of Pennsylvania; Visiting Surgeon, Hospital of the University of Pennsylvania; Surgeon-in-Chief to the Lankenau Hospital. 1634 Walnut St.

1902. Dehoney, Howard, M.D. 240 S. Thirteenth St.

1924. Deichler, L. Waller, M.D., Assistant Surgeon, Wills Hospital; Instructor Ophthalmology, University of Pennsylvania. 2028 Chestnut St.

1923. De Long, Perce, M.D. 1909 Chestnut St.

1885. Dercum, Francis X., A.M., M.D., Ph.D., Professor of Nervous and Mental Diseases in the Jefferson Medical College; Consulting Neurologist to the Philadelphia General Hospital; Foreign Corresponding Member of the Neurological Society of Paris, and Corresponding Member of the Psychiatric and Neurological Society of Vienna. 1719 Walnut St.

‡1908. Despard, Duncan L., M.D., Surgeon to the Abington Memorial Hospital; Assistant Surgeon to the Jefferson Medical College Hospital; Demonstrator of Clinical Surgery in the Jefferson Medical College; Associate in Gynæcology in the Philadelphia Polyclinic Hospital. 256 S. Twenty-first St.

1912. Dewey, J. Hiland, Ph.B., M.D., Assistant Surgeon to Wills Hospital; Ophthalmic Surgeon to St. Francis' Hospital, Trenton, N. J. 1436 Diamond St.

*1911. Dickson, Frank D., M.D. 1807 Federal Reserve Bank Building, Kansas City, Mo.

1908. Dillard, Henry K., Jr., M.D., Physician to the Out-patient Department of the Pennsylvania Hospital; Physician to the Dispensary of the Mary J. Drexel Home. 234 S. Twentieth St.

1924. Dillon, Edward S., A.B., M.D., Assistant Physician, Pennsylvania Hospital; Assistant Instructor in Medicine, School of Medicine, University of Pennsylvania. 2040 Pine St.

1920. Diven, John, A.B., M.D., Pediatrician to St. Christopher's Hospital and Babies' Hospital of Philadelphia. 2002 Spruce Street.

ELECTED

1920. Doane, Joseph Chapman, M.D., Superintendent and Medical Director, Philadelphia General Hospital; Assistant Professor and Instructor in Medicine, Graduate School of Medicine, University of Pennsylvania. Philadelphia General Hospital.

*1897. Dorland, W. A. Newman, A.M., M.D., Professor of Gynecology in the Post-graduate Medical School of Chicago; Professor of Obstetrics in the Chicago College of Medicine and Surgery; Visiting Obstetrician to Cook County Hospital. 25 East Washington Street, Chicago, Ill.

1907. Dorrance, George Morris, M.D., Professor of Maxillo-Facial Surgery, Thomas Evans Institute, University of Pennsylvania; Professor of Surgery and Clinical Surgery, Woman's Medical College; Surgeon in Chief, Woman's College Hospital; Surgeon to St. Agnes Hospital. 2025 Walnut St.

1902. Downs, Robert N., Jr., M.D., Surgeon to the Dispensary of the Germantown Hospital. 6008 Greene St., Germantown.

1910. Drayton, William, Jr., M.D., Physician to the Philadelphia Hospital for Contagious Diseases; Physician to the Outpatient Department of the Pennsylvania Hospital; Physician to the Pennsylvania Institute for the Instruction of the Blind; Assistant Physician to the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases. 2119 Spruce Street.

1911. Earnshaw, Henry Culp, M.S., M.D., Attending Physician to the Hospital of the Good Shepherd, Rosemont; Assistant Attending Physician to the Bryn Mawr Hospital; Attending Physician to the Bryn Mawr Children's Hospital; Pennsylvania Railroad Surgeon. Bryn Mawr, Pa.

*1887. Edwards, William A., M.D., Professor of Pediatrics in the Medical Department of the University of California. R. D. 2, Box 105, El Cajon, Calif.

1924. Egbert, Seneca, M.D. Wayne, Pa.

1911. Eliason, Eldridge E., B.A., M.D., Sc.D., Associate in Surgery in the University of Pennsylvania; Surgeon to the Howard Hospital; Assistant Surgeon to the University of Pennsylvania Hospital, the Philadelphia General Hospital and the American Stomach Hospital 330 S. Sixteenth St.

1904. Elmer, Walter G., B.S., M.D., Associate Professor of Orthopædic Surgery, Graduate School of Medicine, University of Pennslvania; Clinical Professor of Orthopædic

ELECTED

Surgery in the Woman's Medical College of Pennsylvania; Orthopædic Surgeon to the Polyclinic Hospital and to the Philadelphia General Hospital. 1801 Pine St.

1896. Ely, Thomas C., A.M., M.D. 3912 Chestnut St.

1893. Eshner, Augustus A., M.D., Consulting Physician to Mercy Hospital. 1019 Spruce St.

*1905. Evans, Joseph S., Jr., A.B., M.D., Professor of Medicine, Medical School, University of Wisconsin; Physician to State of Wisconsin General Hospital; Consulting Physician, Madison General and St. Mary's Hospitals. 1300 University Ave., Madison, Wis.

1905. Evans, William, M.D. 4007 Chestnut St.

1912. Eves, Curtis C., M.D., Oto-laryngologist to Out-patient Department of the Pennsylvania Hospital; Attending Oto-laryngologist to Bryn Mawr Hospital. 247 S. Seventeenth Street.

1894. Faries, Randolph, M.D. 2030 Chestnut St.

1922. Farley, David L., B.S., M.D., Instructor in Medicine, University of Pennsylvania; Assistant Physician, Pennsylvania Hospital. 1906 Pine St.

†1903. Farr, Clifford B., A.M., M.D., Director of Laboratories, Pennsylvania Hospital, Department for Mental and Nervous Diseases. Bryn Mawr, Pa.

1893. Farr, William W., M.D., Physician to the Leamy Home. 20 W. Ashmead Place, Chestnut Hill.

1884. Fenton, Thomas H., M.D., Ophthalmic Surgeon to St. Vincent's Home, the Baptist Home and the Widener Home for Crippled Children. 1319 Spruce St.

1907. Fetterolf, George, A.B., M.D., Sc.D., Professor of Oto-laryngology, University of Pennsylvania. 2010 Spruce St.

1924. Fewell, Alexander G., M.D. 1924 Pine St.

1907. Fife, Charles A., A.B., M.D., Associate in Pediatrics in the University of Pennsylvania; Pediatrist to the Presbyterian Hospital; Physician to the St. Christopher's Hospital for Children; Assistant Physician to the Philadelphia General Hospital. 2104 Spruce St.

1884. Fisher, Henry M., M.D. 1027 Pine St.

1910. Fisher, John Monroe, M.D., Associate Professor of Gynecology in the Jefferson Medical College; Gynecologist to the Philadelphia, St. Agnes', and Pottstown Hospitals;

ELECTED

Assistant Gynecologist to the Jefferson Medical College Hospital. 345 S. Nineteenth St.

1888. Flick, Lawrence F., M.D. 736 Pine St.

1916. Forst, John R., M.D. 166 W. Coulter St., Germantown.

1908. Foulkrod, Collin, M.D., Obstetrician to the Presbyterian Hospital; Assistant Demonstrator of Obstetrics in Jefferson Medical College. 3910 Chestnut St.

1908. Fox, Herbert, M.D., Director of the William Pepper Laboratory of Clinical Medicine, University of Pennsylvania; Pathologist to the Laboratory of Comparative Pathology of the Zoölogical Society of Philadelphia; Pathologist to the Rush Hospital; Pathologist to the Children's Hospital. 3902 Locust St.

†1885. Fox, Joseph M., M.D. Torresdale, Pa.

1906. Fraley, Frederick, Jr., A.B., M.D. Overbrook, Pa.

‡1903. Francine, Albert Philip, A.B., M.A., M.D., Clinical Director of Tuberculosis, U. S. Veterans' Bureau, Washington, D. C. 3309 Macomb St., N. W., Washington, D. C.

1897. Frazier, Charles H., A.B., M.D., Sc.D., John Rhea Barton Professor of Surgery, University of Pennsylvania. 3600 Walnut St.

1916. Funk, Elmer Hendricks, M.D., Assistant Professor of Medicine in the Jefferson Medical College; Medical Director and Physician-in-Charge of the Department for Diseases of the Chest of Jefferson Hospital; Assistant Physician to the Pennsylvania Hospital; Visiting Physician to the White Haven Sanatorium. 1318 Spruce St.

1899. Gamble, Robert, G. M.D., one of the Attending Physicians to the Bryn Mawr Hospital. Haverford, Pa.

1912. Gaskill, Henry Kennedy, M.D. S. E. Cor. Nineteenth and Spruce Sts.

1917. Gerhard, Arthur Howell, M.D. 1615 N. Delaware Ave.

1902. Ghriskey, Albert A., M.D. 3936 Walnut St.

1899. Gibbon, John H., M.D., Professor of Surgery in the Jefferson Medical College; Surgeon to the Pennsylvania Hospital and Consulting Surgeon to the Bryn Mawr Hospital. 1608 Spruce St.

1920. Gill, A. Bruce, A.B., M.D., Professor of Orthopædic Surgery, University of Pennsylvania; Surgeon to the Orthopædic Hospital; Orthopædic Surgeon to the Episcopal

ELECTED

and Presbyterian Hospitals; Chief Surgeon to the Widener Memorial Industrial Training School for Crippled Children. The Lenox, Thirteenth and Spruce Sts.

*1913. Ginsburg, Nathaniel, M.D. 10 Peterboro Ave., Detroit, Mich.

1897. Girvin, John H., M.D., Gynecologist to the Presbyterian Hospital; Associate Professor of Gynecology, Graduate School of Medicine, University of Pennsylvania. 2120 Walnut St.

1920. Githens, Thomas Stotesbury, M.D. Hamilton Court, Thirty-ninth and Chestnut Sts.

1906. Gittings, J. Claxton, M.D., Professor of Pediatrics, School of Medicine and Graduate School of Medicine, University of Pennsylvania; Visiting Physician to the Children's Hospital of Philadelphia. 1828 Pine St.

1905. Given, Ellis E. W., M.D., Surgeon to the Philadelphia Freemasons Memorial Hospital of the Masonic Home, Elizabethtown, Pa.; Surgeon to the Dispensary of the Episcopal Hospital. 2714 Columbia Ave.

1894. Gleason, E. B., S.B., M.D., LL.D., Professor of Otology in the Medico-Chirurgical College. 2033 Chestnut St.

1906. Goepp, R. Max, M.D., Professor of Medicine, Graduate School of Medicine, University of Pennsylvania. 1814 Spruce St.

1906. Goldberg, Harold G., M.D., Ophthalmic Surgeon to the Episcopal and Misericordia Hospitals, Kensington Hospital for Women and Baltimore and Ohio Railroad. 1925 Chestnut Street.

1908. Goodman, Edward H., M.D., Associate in Medicine in the University of Pennsylvania; Consultant to the Medical Dispensary of the University Hospital; Assistant Physician to the University Hospital; Assistant Physician to the Philadelphia General Hospital; Physician to the Presbyterian Hospital. 248 S. Twenty-first St.

1905. Gordon, Alfred, M.D., Neurologist to the Mt. Sinai, the Northwestern General, and the Douglass Memorial Hospitals. 1812 Spruce St.

1894. Graham, Edwin E., M.D., Professor of Pediatrics in the Jefferson Medical College; Pediatrist to the Jefferson and the Philadelphia General Hospitals; Physician to the Franklin Reformatory Home. 1713 Spruce St.

ELECTED

1904. Grayson, Charles P., M.D., Professor of Laryngology and Rhinology in the University of Pennsylvania; Physician-in-Charge of the Throat and Nose Department of the University Hospital; Otolaryngologist to the Philadelphia General Hospital. 262 S. Fifteenth St.

1910. Greenman, Milton J., M.D., Sc.D., Director of the Wistar Institute of Anatomy and Biology. Wistar Institute of Anatomy and Biology, Thirty-sixth St. and Woodland Ave.

1883. Griffith, J. P. Crozer, A.B., M.D., Ph.D., Professor of Pediatrics in the University of Pennsylvania; Corresponding Member of the Société de Pédiatrie de Paris; Physician to the Children's Hospital of Philadelphia. 1810 Spruce St.

1912. Griscom, J. Milton, B.S., M.D., Assistant Surgeon to the Wills Hospital. 1925 Chestnut St.

1911. Gummey, Frank Bird, M.D., Visiting Physician to the Germantown Hospital and Dispensary; Visiting Physician to the Midnight Mission. 5418 Greene St., Germantown.

*1902. Gwyn, Norman B., M.D., Clinician in Medicine, Toronto General Hospital; Clinician in Medicine, Medical Faculty, University of Toronto School. 48 Bloor St., E., Toronto, Canada.

1894. Hamill, Samuel McC., M.D., Professor of Diseases of Children in the Philadelphia Polyclinic and College for Graduates in Medicine; Pediatrist to the Presbyterian Hospital; Pediatrist to St. Vincent's Home. 1822 Spruce St.

1897. Hand, Alfred, Jr., M.D., Professor of Pediatrics, Graduate School of Medicine, University of Pennsylvania; Visiting Physician to the Children's Hospital, to the Children's Hospital of the Mary J. Drexel Home and to the Methodist Hospital. 1724 Pine St.

1886. Hansell, Howard F., M.D., Professor of Ophthalmology in the Jefferson Medical College; Ophthalmic Surgeon to the Philadelphia General Hospital and to the Jefferson Medical College Hospital; Emeritus Professor of Diseases of the Eye in the Philadelphia Polyclinic. N. E. Cor. Seventeenth and Walnut Sts.

1889. Hare, Hobart A., LL.D., M.D., Professor of Therapeutics, Materia Medica, and Diagnosis in the Jefferson Medical College. 1801 Spruce St.

1903. Hart, Charles D., A.M., M.D., Inspector and Secretary of the Eastern State Penitentiary; National Executive

ELECTED

Committee and Chairman of the Philadelphia Committee, Boy Scouts of America. Chestnut Hill.

1885. HARTE, RICHARD H., M.D. (Hon.), F.R.C.S. Ireland; Adjunct Professor of Surgery in the University of Pennsylvania; Surgeon to the Pennsylvania and the Orthopædic Hospitals; Consulting Surgeon to St. Mary's, Memorial and the Bryn Mawr Hospitals. 1503 Spruce St.

*1888. HARTZELL, MILTON B., A.M., M.D., LL.D., Professor of Dermatology in the University of Pennsylvania. Fayetteville, Pa.

1907. HATFIELD, CHARLES JAMES, A.B (Princeton), M.D., Executive Director of the Henry Phipps Institute for the Study, Treatment, and Prevention of Tuberculosis; Visiting Physician to the White Haven Sanatorium. Phipps Institute, Seventh and Lombard Sts.

1872. HAYS, I. MINIS, M.D. 266 S. Twenty-first St.

1911. HEED, CHARLES R., M.D., Ophthalmologist to Girard College; Assistant Ophthalmologist to the Jefferson Medical College Hospital. 1205 Spruce St.

1908. HEINEBERG, ALFRED, P.D., M.D., Associate in Gynecology in the Jefferson Medical College; Assistant Gynecologist to St. Agnes' Hospital. 1923 Spruce St.

1901. HEISLER, JOHN C., M.D., Professor of Anatomy, University of Pennsylvania. 3829 Walnut St.

1903. HENRY, J. NORMAN, M.D., Physician to the Pennsylvania Hospital; Clinical Professor of Medicine in the Woman's Medical College of Pennsylvania; Assistant Physician to the Philadelphia General Hospital. 1906 Spruce St.

1891. HEWSON, ADDINELL, A.B., A.M., M.D., Professor of Anatomy in the Philadelphia Polyclinic and College for Graduates in Medicine; Professor of Anatomy and Histology in the Temple University; Surgeon to Memorial Hospital, Roxborough. 326 S. Fifteenth St.

1924. HEWSON, WILLIAM, A.B., M.D., Instructor in Cardiology, Graduate School of Medicine, University of Pennsylvania; Acting Chief of Cardiac Clinic, Presbyterian Hospital; Dispensary Physician, Bryn Mawr Hospital; Laryngologist, Pennsylvania Institution for Instruction of Blind. 6300 Overbrook Ave.

1909. HIGBEE, WILLIAM S., M.D., President of the Pennsylvania State Board of Examiners for Registration of Nurses. 5121 Pine St.

ELECTED

1897. Hinkle, William M., M.D., Lecturer on the Anatomy and Physiology of the Vocal Organs in the National School of Elocution and Oratory. 923 N. Sixty-fourth St.

*1892. Hinsdale, Guy, A.M., M.D. Hot Springs, Virginia.

*1888. Hirsh, A. Bern, M.D., Chief of Physiotherapy and Occupational Therapy, United States Veterans' Bureau, District No. 2; Consulting Physician for Physiotherapy, Beth Israel Hospital. 67 W. Ninety-fourth St., New York City.

1888. Hirst, Barton Cooke, A.B., M.D., LL.D., Professor of Obstetrics in the University of Pennsylvania; Gynecologist to the Philadelphia General and the Howard Hospitals. 1821 Spruce St.

1903. Hirst, John Cooke, M.D., Associate Professor of Gynecology, Graduate School of Medicine, University of Pennsylvania; Associate in Obstetrics, School of Medicine, University of Pennsylvania; Obstetrician-in-Chief, St. Agnes' Hospital; Gynecologist-in-Chief to Mt. Sinai Hospital. 1823 Pine St.

1924. Hirst, John C., 2nd, A.B., M.D., Instructor in Obstetrics, School of Medicine, University of Pennsylvania; Assistant Obstetrican, Philadelphia General and Howard Hospitals; Assistant Surgeon, Department of Obstetrics, University Hospital. 1918 Pine St.

*1908. Hitchens, Arthur Parker, M.D., Instructor in Bacteriology, Army Medical School; Special Lecturer, Infection and Immunity, Graduate School, Department of Agriculture; Advisory Professor in Bacteriology, American University. Washington, D. C.

1924. Hitschler, William A., M.D., Professor of Rhinology, Temple University. 1635 Spruce St.

1905. Hodge, Edward Blanchard, A.B., M.D., Surgeon to the Presbyterian and the Children's Hospitals; Associate Surgeon to the Pennsylvania Hospital; Associate Surgeon to the Widener Memorial Training School. 2019 Spruce St.

1913. Hoffman, Clarence, M.D., 1630 Pine St.

1906. Holloway, Thomas B., M.S., M.D., Vice-Dean for and Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Instructor in Ophthalmology in the University of Pennsylvania; Attending Surgeon to the Wills Hospital; Ophthalmologist to the Pennsylvania Institution for the Instruction of the Blind at Overbrook. 1819 Chestnut St.

1914. Hooker, Richard S., M.D. 2147 N. Howard St.

ELECTED

1919. Hopkins, Arthur H., B.S. (Haverford), M.D., Associate in Medicine and Instructor in Practical Therapeutics, University of Pennsylvania; Physician to the Protestant Episcopal Hospital; Consulting Physician to the Chester County Hospital, West Chester, Pa. 1726 Pine St.

1908. Hoyt, Daniel M., M.D., Assistant Visiting Physician to the Philadelphia General Hospital. The Tracy, Thirty-sixth and Chestnut Sts.

*1912. Huber, G. Carl, M.D., Professor of Anatomy and Director of the Anatomic Laboratories in the University of Michigan. 1330 Hill St., Ann Arbor, Mich.

1892. Hughes, William E., M.D., Visiting Physician to the Philadelphia General Hospital; Consulting Physician to the Presbyterian Hospital. 3945 Chestnut St.

1923. Hume, John E., A.B., M.D., Visiting Physician, Medical Department, Howard Hospital. 1829 Spruce St.

1912. Hunter, John W., B.S., M.D. 4715 Chester Ave.

1921. Hunter, Robert J., M.D., Laryngologist, Philadelphia General Hospital; Chief of Dispensary and Assistant Laryngologist and Aurist, Howard Hospital; Instructor in Otology, University of Pennsylvania, Graduate School. 2011 Chestnut St.

1898. Hutchinson, James P., M.D., Surgeon to the Pennsylvania, the Methodist, the Children's, Memorial and the Bryn Mawr Hospitals; Adjunct Professor of Surgery in the University of Pennsylvania. 133 S. Twenty-second St.

‡1871. Ingham, James V., M.D. 1811 Walnut St.

1921. Ivy, Robert H., D.D.S., M.D., Professor of Clinical Maxillo-Facial Surgery, University of Pennsylvania; Oral Surgeon to the Hospitals of the Graduate School of Medicine, University of Pennsylvania and to the Philadelphia General Hospital; Consultant in Maxillo-Facial Surgery, Walter Reed General Hospital, Washington, D. C. 1503 Medical Arts Building.

1917. Jackson, Chevalier, M.D., Sc.D., Professor of Laryngology, Jefferson Medical College; Professor of Bronchoscopy and Esophagoscopy, Graduate School of Medicine, University of Pennsylvania. 128 S. Tenth St.

*1885. Jackson, Edward, A.M., M.D., Sc.D., Emeritus Professor of Ophthalmology in the University of Colorado; Emeritus

ELECTED

Professor of Diseases of the Eye in the Philadelphia Polyclinic. 314 Fourteenth St., Denver, Col.

*1906. Jacobs, Francis Brinton, B.S., M.D., Assistant Surgeon to the Chester County Hospital. Whitford, Pa.

1922. Jameson, Howard Leon, M.D., Assistant Professor of Medicine, Graduate School of Medicine, University of Pennsylvania; Assistant Physician, Medico-Chirurgical and Polyclinic Hospitals. 2133 S. Sixteenth St.

1920. Janvier, G. Victor, M.D., Instructor in Obstetrics, University of Pennsylvania; Assistant Obstetrician to the Philadelphia General Hospital and the University of Pennsylvania Hospital; Associate in Gynecology at the American Stomach Hospital. Lansdowne, Pa.

1913. Jefferys, William Hamilton, A.B., A.M., M.D. New Street, Chestnut Hill.

1919. Jenks, Horace H., A.B., M.D., Medical Director, Associated Medical Clinics; Physician to the Out-Patient Department, Children's Hospital; Instructor in Pediatrics, Graduate School of Medicine, University of Pennsylvania. 918 Clinton Street.

1898. Johnson, Russell H., A.B. (Princeton), M.D., Physician to the Pennsylvania Institution for the Deaf and Dumb. Chestnut Hill, Philadelphia.

1918. Jonas, Leon, M.D. 2253 N. 17th St.

1900. Jones, Charles James, A.M., M.D., LL.D., Ophthalmic Surgeon to St. Joseph's Hospital; Ophthalmic Surgeon to the House of the Good Shepherd, Germantown; Consulting Ophthalmologist to St. Vincent's Home. 256 S. Fifteenth St.

1924. Jones, Harold W., M.D., Demonstrator of Medicine, Jefferson Medical College; Assistant Physician, Philadelphia General Hospital. 1426 Spruce St.

1913. Jones, John F. X., B.S., A.B., A.M., M.D., Surgeon to St. Joseph's, Misericordia and St. Agnes' Hospitals. 103 S. Twenty-first St.

1900. Jopson, John H., M.D., Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon to the Presbyterian and the Children's Hospitals and Hospitals of the Graduate School of Medicine, University of Pennsylvania. 1824 Pine St.

1900. Judson, Charles F., A.B., M.D., Physician to Out-patient Department of the Lankenau Hospital and to the Southern Home for Children. 1005 Spruce St.

ELECTED

1902. Jump, Henry D., M.D., Professor of Applied Therapeutics and Clinical Medicine, Woman's Medical College; Physician to Philadelphia General and Misericordia Hospitals. 2019 Walnut St.

1886. Jurist, Louis, M.D. 1308 N. Broad St.

1903. Kalteyer, Frederick J., M.D., Associate Professor of Medicine, Jefferson Medical College; Assistant Physician, Jefferson Medical College Hospital; Consulting Physician to the Pottstown Hospital, Pottstown, Pa. 1530 Locust St.

*1910. Karsner, Howard T., M.D., Professor of Pathology in the Western Reserve University Medical School. 2109 Adelbert Rd., Cleveland, Ohio.

1923. Kay, James, M.D., Visiting Physician, Episcopal Hospital; Assistant Instructor of Medicine, Jefferson Medical College. 600 W. Olney Ave.

1920. Keating, Peter McCall, M.D., Chief of Surgical Dispensary, St. Agnes Hospital; Assistant Attending Surgeon, Bryn Mawr Hospital; Assistant, Surgical Out-patient Department, Pennsylvania Hospital; Pathologist, Chester County Hospital. 2130 Pine St.

1924. Keeler, J. Clarence, M.D., Associate Professor of Otology, Jefferson Medical College and Hospital; Assistant in Oto-laryngology, Germantown Hospital; Consultant Oto-laryngologist, Pottstown Hospital, Pa., and Newcombe Hospital, Vineland, N. J. Medical Arts Building.

†1867. Keen, William W., M.D., LL.D. (Hon.), Ph.D. (Upsala) (Hon.), Sc.D. (Jefferson and Harvard), Dr., Honoris Causa, University of Paris; (Hon.) F.R.C.S. (Eng., Edin. and Ireland), Emeritus Professor of Surgery, Jefferson Medical College; Hon. Foreign Associate, Paris Academy of Medicine; Hon. Foreign Member, Paris Surgical Society and Belgian Surgical Society and the Royal Academy of Medicine of Belgium; Hon. Foreign Member, Royal Society of Medicine, London. 1520 Spruce St.

1912. Keene, Floyd E., M.D., Instructor in Gynecology in the University of Pennsylvania; Assistant Gynecologist to the University Hospital; Gynecologist to the Chestnut Hill Hospital. Medical Arts Building.

1913. Kelly, Francis Joseph, M.D. 2035 Chestnut St.

*1887. Kelly, Howard A., A.B., M.D., LL.D. (Aberdeen, Wash. and Lee, and Univ. of Pa.), Professor of Gynecology in

ELECTED

Johns Hopkins University and Gynecologist to the Johns Hopkins Hospital, Baltimore, Md.; Hon. Fellow of the Edinburgh Obstetrical Society, the Royal Academy of Medicine of Ireland, and of the Glasgow Obstetrical and Gynecological Society. 1418 Eutaw Place, Baltimore, Md.

1909. KELLY, JAMES A., A.M., M.D., Visiting Surgeon to St. Mary's and Memorial Hospitals; Associate in Surgery in the Philadelphia Polyclinic and College for Graduates in Medicine; Assistant Visiting Surgeon to St. Joseph's Hospital. 1815 Spruce St.

1912. KELLY, THOMAS C., A.M., M.D., Associate in Medicine, University of Pennsylvania; Assistant Professor of Medicine, Graduate School, University of Pennsylvania; Pediatrist to St. Christopher, Misericordia and St. Mary's Hospitals; Assistant Physician, Philadelphia General Hospital. 105 School Lane, Germantown.

1898. KEMPTON, AUGUSTUS F., M.D. 2118 Pine St.

1905. KERCHER, DELNO E., M.D. 1534 Pine St.

1921. KERN, RICHARD A., A.B., M.D., Associate in Medicine, University of Pennsylvania; Assistant Physician, University Hospital; Associate in Medicine, Graduate School of Medicine, University of Pennsylvania. 906 Medical Arts Building.

1920. KLAUDER, JOSEPH VICTOR, M.D., Professor of Dermatology, Woman's Medical College; Associate Professor, Dermatology and Syphilology, Graduate School of Medicine, University of Pennsylvania; Dermatologist, Misericordia, Woman's Medical College and American Stomach Hospitals; Assistant Dermatologist, Philadelphia General Hospital. 1934 Spruce Street.

1920. KLEIN, THOMAS, M.D., Associate Professor of Medicine, Graduate School, University of Pennsylvania; Assistant Physician, Presbyterian Hospital. 250 S. Eighteenth St.

1913. KLOPP, EDWARD J., M.D., Instructor in Surgery in the Jefferson Medical College; Assistant Surgeon to the Germantown Hospital; Chief Clinical Assistant in the Surgical Department of the Jefferson Hospital; Assistant Surgeon to the Out-patient Department of the Pennsylvania Hospital 1611 Spruce St.

1895. KNEASS, SAMUEL S., M.D., Associate in the William Pepper Laboratory of Clinical Medicine in the University of Pennsylvania. 1510 Walnut St.

ELECTED

1908. Knipe, Jay C., M.D., Ophthalmologist to the Jewish Hospital; Assistant Ophthalmologist to the Philadelphia General Hospital and to the Mary J. Drexel Home; Chief of the Eye Clinic at the Jefferson Medical College Hospital; Demonstrator of Osteology and Syndesmology in the Jefferson Medical College. 2035 Chestnut St.

1919. Knipe, Norman Leslie, Ph.B. (Cornell); M.D., Instructor in Obstetrics, University of Pennsylvania; Assistant Obstetrician, University Hospital; Gynecologist, St. Mary's Hospital; Associate Gynecologist, American Stomach Hospital. 2018 Chestnut St.

1908. Knowles, Frank Crozer, M.D., Professor of Dermatology, Jefferson Medical College; Dermatologist to the Presbyterian and Children's Hospitals; Chief of Clinic, Pennsylvania Hospital. 2022 Spruce St.

1914. Kolmer, John A., M.D., Dr. P.H., M.Sc., Professor of Pathology and Bacteriology, Graduate School of Medicine, University of Pennsylvania; Head of the Department of Pathology and Bacteriology in the Dermatological Research Laboratories of Philadelphia; Consulting Pathologist to St. Vincent's and Misericordia Hospitals; Consulting Serologist to Memorial and Germantown Hospitals. Cynwyd, Pa.

1904. Krauss, Frederick, M.D., Ophthalmic Surgeon to the Episcopal Hospital; Ophthalmic Surgeon to St. Christopher's Hospital for Children; Laryngologist to the Abington Hospital. 1701 Chestnut St.

1914. Krumbhaar, Edward B., A.B., Ph.D., M.D., Director of Laboratories, Philadelphia General Hospital; Associate Professor of Pathology, Graduate School of Medicine, University of Pennsylvania. Box 4310, Chestnut Hill.

1900. Krusen, Wilmer, M.D., Professor of Gynecology in the Medical Department of Temple University; Chief Gynecologist to the Samaritan and the Garretson Hospitals; Consulting Gynecologist to the Charity and Mercy Hospitals. 127 N. Twentieth St.

*1909. Laird, J. Packard, M.D. 483 N. E. Twenty-seventh St., Miami, Florida.

1904. Landis, Henry R. M., M.D., Director of the Clinical and Sociological Departments of the Henry Phipps Institute of the University of Pennsylvania; Visiting Physician to the White Haven Sanatorium. 1817 Pine St.

ELECTED

1907. Langdon, H. Maxwell, M.D., Associate Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Instructor of Ophthalmology, Under-Graduate School, University of Pennsylvania; Ophthalmologist of the Presbyterian, Orthopædic and Children's Hospitals. 1530 Locust St.

1922. Lawrance, Stuart J., M.D., Obstetrician, St. Mary's Hospital. 1332 Spruce St.

1922. Leach, Wilmon W., M.D., Physician to Dispensary, Children's Hospital. 2118 Spruce St.

1920. Leavitt, Frederick Headley, M.D. 1527 Pine St.

1904. Le Boutillier, Theodore, M.D., Assistant Professor, Epidemic Contagious Diseases, Graduate School of Medicine, University of Pennsylvania; Senior Pediatrist, Philadelphia Hospital for Contagious Diseases; Visiting Physician, Babies' Hospital, North Philadelphia. 2017 Spruce St.

‡1893. Le Conte, Robert G., A.B., M.D., Surgeon to the Pennsylvania Hospital; Consulting Surgeon to the Bryn Mawr and Germantown Hospitals. 2000 Spruce St.

1908. Lee, Walter Estell, M.D., Surgeon to the Germantown, Children's, Pennsylvania and Bryn Mawr Hospitals and the Associated Medical Clinics; Associate Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Consulting Surgeon, Chester County Hospital, West Chester, Pa. 905 Pine St.

1903. Leffmann, Henry, A.M., M.D., D.D.S., Ph.D., Honorary Professor of Chemistry, Wagner Free Institute of Science; Emeritus Pathological Chemist, Jefferson Hospital; Lecturer on Research, Philadelphia College of Pharmacy and Science. Atlantic City, N. J.

1892. Leidy, Joseph, M.D., Officier d'instruction publique, France; Consulting Physician to the Pennsylvania Training School for Feeble-minded Children. 1713 Walnut St.

1920. Leopold, Simon S., M.D. 2025 Spruce St.

1915. Lewis, Fielding O., M.D., Associate in Laryngology in the Jefferson Medical College Hospital; Operating Clinical Chief of the Laryngological Dispensary and Clinical Assistant of the Otological Dispensary of the Jefferson Medical College Hospital; Laryngologist of the Philadelphia General Hospital. 261 S. Seventeenth St.

1877. Lewis, Morris J., M.D., Attending Physician to the Orthopædic Hospital and Infirmary for Nervous Diseases and

ELECTED

Emeritus Physician to the Pennsylvania Hospital. 1316 Locust St.

*1911. Lewis, Paul A., M.D. Princeton, N. J.

1904. Lindauer, Eugene, M.D., Assistant Neurologist to the Philadelphia General and Polyclinic Hospitals; Instructor in Nervous Diseases, Graduate School of Medicine, University of Pennsylvania. 6451 N. Broad St.

1886. Lloyd, J. Hendrie, A.M. (Princeton), M.D., Neurologist to the Philadelphia General Hospital and to the Methodist Episcopal Hospital; Consulting Neurologist to the State Asylum for the Chronic Insane at Wernersville, and to the Pennsylvania Training School for Feeble-minded Children at Elwyn. 4057 Spruce St.

1907. Lodholz, Edward, M.D., Isaac Ott Professor of Physiology, Graduate School of Medicine, University of Pennsylvania. Medical Laboratories, University of Pennsylvania.

1893. Longaker, Daniel, M.D., Obstetrician to the Kensington Hospital for Women and Visiting Obstetrician to the Jewish Maternity Hospital. 1806 Spruce St.

1907. Loux, Hiram R., M.D., Professor of Genito-urinary Surgery in the Jefferson Medical College; Surgeon to the Philadelphia General Hospital. Medical Arts Building, Sixteenth and Walnut Sts.

1921. Lucke, Baldwin, Dr. P.H., M.D., Assistant Pathologist, University and Philadelphia General Hospitals. Assistant Professor of Pathology, Medical School, University of Pennsylvania.

1924. Ludy, John B., A.B., A.M., M.D., Dermatologist, Lankenau and Methodist Hospitals; Assistant Dermatologist, Pennsylvania, Episcopal and Philadelphia General Hospitals. Medical Arts Building.

1923. Lueders, Charles W., A.B., M.D., Biochemist, Pennsylvania Hospital for Mental and Nervous Diseases; Research Worker, Gastro-enterology, Jefferson Medical College. Medical Arts Building.

1919. Lynch, Frank B., Jr., M.D., Dickson Fellow in Bacteriology to the Pepper Laboratory of Clinical Medicine, University of Pennsylvania; Serologist, University Hospital; Instructor in Pathology, Evans Institute, University of Pennsylvania. 6028 Columbia Ave.

1914. Lyon, B. B. Vincent, A.B. (Williams Coll.), M.D. (Johns Hopkins), Associate in Medicine, Jefferson Medical College;

ELECTED

Chief-of-Clinic, Gastro-Intestinal Department, Jefferson Hospital; Visiting Physician to Methodist Hospital. 328 S. Twenty-first St.

1900. McCarthy, Daniel J., M.D., Professor of Medical Jurisprudence (George B. Wood Foundation) in the University of Pennsylvania; Neurologist to the Philadelphia General and St. Agnes' Hospitals, and to the Henry Phipps Institute. 2025 Walnut St.

1913. McCrae, Thomas, B.A., M.D., F.R.C.P. (Lond.), Professor of Medicine in the Jefferson Medical College; Physician to the Jefferson and Pennsylvania Hospitals. 1929 Spruce Street.

1895. McFarland, Joseph, M.D., Sc.D., Professor of Pathology and Bacteriology in the Medical Department of the University of Pennsylvania; Pathologist to the Philadelphia General Hospital. 442 W. Stafford St., Germantown.

1905. McKenzie, R. Tait, M.D., LL.D., Professor of Physical Education and Director of the Department of Physical Education in the University of Pennsylvania. 2014 Pine St.

1916. McKnight, Howard A., A.B., M.D., Assistant Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Associate Professor of Surgery, Woman's Medical College of Pennsylvania; Surgeon, St. Mary's and Woman's College Hospitals; Chief, Surgical Clinic, Polyclinic and Medico-Chirurgical Hospitals. 345 S. Nineteenth Street.

1915. McLean, John D., M.D. 4316 Chestnut St.

1924. McMillan, Thomas M., A.B., M.D., Assistant Physician, Pennsylvania Hospital; Cardiologist, Philadelphia General Hospital; Assistant Instructor in Medicine, School of Medicine, University of Pennsylvania; Instructor in Medicine, Graduate School of Medicine, University of Pennsylvania. 2044 Locust St.

1924. McPhedran, F. Maurice, A.B., M.D., Assistant in Clinical Research, Henry Phipps Institute. Seventh and Lombard Streets.

*1900. McReynolds, Robert Phillips, M.D. 213 S. Broadway, Los Angeles, Calif.

‡1886. MacCoy, Alexander W., M.D., Consulting Laryngologist to the Bryn Mawr Hospital. Haverford Court, Haverford, Pa.

ELECTED

1910. MACKINNEY, WILLIAM H., M.D., Assistant Surgeon to the Dispensary for Genito-urinary Diseases, University Hospital; Assistant in the Urological Dispensary of the Lankenau Hospital. 1701 Chestnut St.

1901. MACLEOD, GEORGE I., M.D. Ardmore, Pa.

1914. MAIER, F. HURST, M.D., Associate in Gynecology to the Jefferson Medical College; Gynecologist to St. Joseph's Hospital; Gynecologist, Obstetrician and Consultant, Prenatal Clinic, Philadelphia General Hospital; Associate Gynecologist, St. Mary's Hospital. 2019 Walnut St.

1913. MAJOR, C. PERCY, M.D., Physician to the Dispensary of the Germantown Hospital; Pediatrist to the Dispensary of the Germantown Hospital; Pediatrist to the Abington Memorial Hospital. Tenth and Oak Lane.

1913. MANGES, WILLIS F., M.D., Roentgenologist to the Jefferson Hospital; Director of the Roentgen-ray Laboratory in the Philadelphia General Hospital. 235 S. Fifteenth St.

1898. MARSHALL, GEORGE MORLEY, M.D., Laryngologist to the Philadelphia General Hospital; Laryngologist and Otologist to St. Joseph's Hospital. 1819 Spruce St.

1889. MARTIN, EDWARD, M.D., Professor of Surgical Physiology, University of Pennsylvania. 135 S. Eighteenth St.

*1911. MEIGS, EDWARD BROWNING, A.B., M.D., Physiologist in the Dairy Division of the United States Department of Agriculture. 1445 Rhode Island Ave., N. W., Washington, D. C.

1914. MENCKE, J. BERNHARD, A.B., M.D., Assistant Surgeon to the Lankenau Hospital; Surgeon to the Out-patient Department of the Lankenau Hospital. 1816 Spruce St.

1923. MENDELSON, WALTER, M.D. 639 Church Lane, Germantown.

1914. MERRILL, WILLIAM JACKSON, A.B., M.D., Associate Professor of Orthopædic Surgery, Graduate School of Medicine, University of Pennsylvania; Orthopædic Surgeon to the Children's Hospital, Germantown Hospital, Children's Seashore House; Consulting Orthopædic Surgeon to the Howard Hospital and Glen Mills School. 2017 Spruce St.

‡1923. METHENY, DAVID G., M.D., 4609 Spruce St.

*1894. MILLER, D. J. MILTON, M.D., Associate Physician to the Children's Hospital, Philadelphia; Pediatrist to the Bamberger Home for Invalid Children, Longport, N. J. N. W. Cor. Pacific and California Aves., Atlantic City, N. J.

1922. MILLER, EDWIN B., M.D., Assistant Professor of Ophthalmology, Graduate School of Medicine, University of Penn-

ELECTED

sylvania; Associate in Ophthalmology, Temple University; Ophthalmologist, Roosevelt Hospital. 2008 Walnut St.

‡1910. MILLER, MORRIS BOOTH, M.D., Professor of Surgery in the Philadelphia Polyclinic; Surgeon to the Douglass Memorial Hospital; Assistant Surgeon to the Philadelphia General Hospital. 2310 Pine St.

1921. MILLER, T. GRIER, A.B., M.D., Assistant Physician, University Hospital; Associate in Medicine, University of Pennsylvania. 110 S. Twentieth St.

1881. MILLS, CHARLES K., M.D., LL.D., Emeritus Professor of Neurology in University of Pennsylvania; Neurologist to Philadelphia General Hospital; Consulting Physician to the Orthopædic Hospital and Infirmary for Nervous Diseases. 2121 DeLancey St.

*1917. MITCEHLL, A. GRAEME, M.D., Professor of Pediatrics, University of Cincinnati; Director of Pediatric Service, Cincinnati General Hospital; Dean of Staff of Children's Hospital, Cincinnati. Cincinnati General Hospital.

1904. MITCHELL, CHARLES F., M.D., Surgeon to the Pennsylvania, Bryn Mawr, and Germantown Hospitals. 332 S. Fifteenth Street.

1921. MOHLER, HENRY K., P.D., M.D., Associate in Medicine, Jefferson Medical College; Medical Director, Jefferson Hospital. 319 S. Sixteenth St.

*1908. MONTGOMERY, CHARLES M., A.B., M.D., U.S.P.H.S. Hospital, Oteen, N. C.

1882. MONTGOMERY, EDWARD E., A.M., M.D., LL.D., Gynecologist to the Jefferson Medical College Hospital and to St. Joseph's Hospital. 1429 Walnut St.

1923. MOORE, WILLIAM F., M.D., Assistant, Bronchoscopic Clinic, Jefferson Hospital; Brochoscopist to Philadelphia General Hospital and Philadelphia Hospital for Contagious Diseases; Assistant Laryngologist, Children's Hospital, Out-Patient Department; Laryngologist to Tuberculosis Department, Philadelphia General Hospital. 255 S. Sixteenth St.

1924. MOORHEAD, STIRLING W., A.B., M.D., Associate in Urology, School of Medicine, University of Pennsylvania; Assistant Surgeon, Department of Genito-urinary Surgery and in Urological Dispensary, University Hospital; Urologist, Howard Hospital. 1523 Pine St.

1918. MORGAN, ARTHUR C., M.D., Professor of Applied Therapeutics, Medical Department, Temple University; Visiting

ELECTED

Physician to Tuberculosis Department, Philadelphia General Hospital; Physician-in-Chief to the Frankford Hospital. 2018 Chestnut St.

1886. Morris, Caspar, M.D. 2050 Locust St.

1893. Morris, Elliston J., M.D., Physician to the Episcopal Hospital. 128 S. Eighteenth St.

1883. Morris, Henry, M.D., Emeritus Professor of Anatomy in the Woman's Medical College of Pennsylvania; Consulting Physician to St. Joseph's Hospital. 2310 Pine St.

1897. Morton, Samuel W., M.D. Aldine Hotel.

1905. Müller, George P., M.D., Professor of Clinical Surgery, University of Pennsylvania; Surgeon to the University and Misericordia Hospitals; Consulting Surgeon to the Chester County and Chambersburg Hospitals. 1930 Spruce St.

1915. Musser, John H., Jr., B.S., M.D., Assistant Professor in Medicine in the University of Pennsylvania; Physician to the Philadelphia General Hospital; Physician-in-Charge, Medical Dispensary, University Hospital; Dispensary Chief and Assistant Physician in the Presbyterian Hospital. 1551 Canal St., New Orleans, La.

1905. Mutschler, Louis H., M.D., Surgeon to the Episcopal Hospital; Assistant Surgeon to the Orthopædic Hospital. 1625 Spruce St.

*1896. Myers, T. D., M.D. 831 University Ave., San Francisco, Calif.

1902. Nassau, Charles F., M.D., LL.D., Associate Professor of Surgery in the Jefferson Medical College; Surgeon to St. Joseph's Hospital; Chief Surgeon to the Frankford Hospital; Surgeon to Mount Sinai Hospital. 1710 Locust St

1886. Neff, Joseph S., A.M., M.D., LL.D., D.P.H., Narberth, Pa.

1887. Neilson, Thomas Rundle, A.M., M.D., Surgeon Emeritus to the Episcopal Hospital; Consulting Surgeon to St. Christopher's Hospital for Children; Emeritus Professor of Genito-urinary Surgery in the University of Pennsylvania. 1937 Chestnut St.

1905. Newcomet, William S., M.D., Physician in Charge of Radiological Department, Jefferson, Presbyterian and Oncologic Hospitals. 3501 Baring St.

1905. Newlin, Arthur, B.S., M.D., Physician to the Pennsylvania Hospital; Physician to the Dispensary of the Children's

ELECTED

Hospital; Assistant Physician to the Orthopædic Hospital. 1804 Pine St.

1899. Nicholson, William Rufus, A.B., M.D., Professor of Gynecology, Graduate School of Medicine, University of Pennsylvania; Attending Gynecologist and Attending Obstetrician to the Methodist Episcopal Hospital; Attending Obstetrician to the Presbyterian Hospital. 2023 Spruce St.

1889. Noble, Charles P., M.D., Sc.D. (Hon.), Formerly Surgeon-in-Chief, Kensington Hospital for Women; Formerly Clinical Professor of Gynecology, Woman's Medical College. Radnor, Pa.

1905. Norris, Charles C., M.D., Associate in Gynecology, University of Pennsylvania Medical School; Assistant Professor, Graduate School of Medicine, University of Pennsylvania; Assistant Gynecologist to the Hospital of the University of Pennsylvania; Gynecologist to the Children's Hospital, Philadelphia; Gynecologist and Obstetrician, Philadelphia General Hospital. Coronado, Twenty-second and Chestnut Streets.

1905. Norris, George William, A.B., M.D., Professor of Clinical Medicine in the University of Pennsylvania; Physician-in-Chief, Medical Service "A", Pennsylvania Hospital. 1820 S. Rittenhouse Square.

*1901. Norris, Henry, M.D., Surgeon to the Rutherford Hospital. Rutherfordton, N. C.

1892. Norris, Richard C., M.D., Lecturer on Clinical and Operative Obstetrics in the University of Pennsylvania; Obstetrician in Charge of the Preston Retreat; Visiting Obstetrician to the Philadelphia General Hospital; Gynecologist to the Methodist Episcopal Hospital, and Consulting Obstetrician and Attending Gynecologist to the Southeastern Dispensary and Hospital. 500 N. Twentieth St.

1913. O'Neal, Alexander H., A.B., A.M., M.D., Physician to the Cathcart and Richardson Homes, Devon; Anesthetizer to the Bryn Mawr Hospital. St. Davids, Pa.

1924. Opie, Eugene L., A.B., M.D., Professor of Experimental Pathology, University of Pennsylvania; Director of Laboratories, Henry Phipps Institute. Phipps Institute, Seventh and Lombard Sts.

1920. Ostheimer, Alfred J., A.B., M.D., L.R.C.P. (London), M.R.C.S. (England), Medical Director, Mental Hygiene

ELECTED

Division, Public Charities Association of Pennsylvania; Consulting Neurologist, State Hospital, Norristown, Pa. Jenkintown, Pa.

1903. Ostheimer, Maurice, A.B., M.D., Assistant Professor of Pediatrics in the University of Pennsylvania; Physician-in-Charge of the Children's Dispensary and Assistant Visiting Physician, Children's Ward, University Hospital. 2204 DeLancey Place.

1913. Outerbridge, George W., A.B., M.D., Associate Professor of Gynecology, Graduate School of Medicine, University of Pennsylvania; Assistant Gynecologist to the Methodist Hospital; Gynecologist to the Abington Memorial Hospital. 1927 Spruce St.

1915. Owen, Hubley R., M.D., Professor of Clinical Surgery, Woman's Medical College; Surgeon, Philadelphia General Hospital; Assistant Surgeon, Orthopædic Hospital; Chief Surgeon, Bureaus of Police and Fire, Philadelphia. Earle Building.

1897. Packard, Francis R., M.D., Chief of the Ear, Nose and Throat Service, Pennsylvania Hospital; Consulting Laryngologist and Aurist, Bryn Mawr Hospital; Consulting Aurist Chestnut Hill Hospital; Laryngologist, Children's Hospital of Philadelphia. 304 S. Nineteenth St.

1898. Page, Henry F., M.D., Assistant Physician to the Lankenau Hospital and Physician to the Medical Dispensary of the same; Clinical Professor of Medicine in the Woman's Medical College of Pennsylvania. 315 S. Sixteenth St.

1906. Pancoast, Henry K., M.D., Professor of Roentgenology in the University of Pennsylvania and Roentgenologist to the University Hospital. Ardmore, Pa.

1909. Parish, Benjamin D., B.S., M.D., Assistant Instructor in Otology in the University of Pennsylvania; Assistant Surgeon to the Dispensary for Diseases of the Ear, University Hospital; Aurist and Laryngologist to St. Agnes' Hospital. 1927 Spruce St.

1899. Parke, William E., M.D., Consulting Obstetrician to the Episcopal Hospital; Associate Surgeon to the Kensington Hospital for Women; Gynecologist to the Frankford Hospital. 1739 N. Seventeenth St.

1910. Patterson, Ross Vernet, M.D., Dean and Associate Professor of Medicine, Jefferson Medical College; Physician

ELECTED

to the Philadelphia General Hospital; Physician to the Protestant Episcopal Hospital; Assistant Physician to the Jefferson Hospital. 2126 Spruce St.

*1903. Pearce, Richard M., M.D., Sc.D., Director of Division of Medical Education, Rockefeller Foundation. 150 E. Seventy-third St., New York, N. Y.

1922. Pelouze, P. S., M.D., Associate in Urology, University of Pennsylvania; Surgeon-in-Charge, Urological Dispensary, University Hospital. Medical Arts Building.

1909. Pemberton, Ralph, M.S., M.D., Physician to the Presbyterian Hospital; Director of the Department of Clinical Chemistry in the Pathological Laboratory of the Presbyterian Hospital. 2120 Sansom St.

†1889. Penrose, Charles Bingham, M.D., Ph.D. (Harvard), Formerly Professor of Gynecology in the University of Pennsylvania. 1720 Spruce St.

1914. Pepper, O. H. Perry, B.S., M.D., Assistant Professor of Medicine, University of Pennsylvania. Medical Arts Bldg.

†1902. Pepper, William, A.B., M.D., Dean of the School of Medicine, University of Pennsylvania; Member of the Council on Medical Education and Hospitals of the American Medical Association. University of Pennsylvania.

1916. Percival, Milton Fraser, M.D. 2332 S. Broad St.

1917. Peter, Luther C., A.M., M.D., Professor of Diseases of the Eye, Temple Medical School; Professor of Ophthalmology, University of Pennsylvania Graduate School. N. E. Cor. Twentieth and Chestnut Sts.

1912. Petty, Orlando H., B.S., A.M., M.D., Professor of Diseases of Metabolism, Graduate School of Medicine, University of Pennsylvania; Chief of Department of Metabolism, Philadelphia General Hospital; Physician to Memorial Hospital; Chief of Department of Diabetes, Memorial Hospital. 6215 Ridge Ave., Roxborough.

1905. Pfahler, George E., M.D., Assistant Radiologist, Medico-Chirurgical Hospital; Assistant Professor of Radiology, Graduate School of Medicine, University of Pennsylvania. 1321 Spruce St.

1915. Pfeiffer, Damon B., A.B., M.D., Assistant Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon, Methodist and Abington Memorial Hospitals; Assistant Surgeon, Presbyterian and Lankenau Hospitals. 1822 Pine St.

ELECTED

1907. Pfromm, George W., Ph.G., M.D., Assistant Physician to the American Stomach Hospital; Consulting Physician to the German Protestant Home for the Aged. 1431 N. Fifteenth St.

1907. Phillips, Horace, M.D., Assistant Surgeon, U. S. Public Health Service; Examining Physician, Office of the District Attorney. 905 Land Title Building.

‡1883. Piersol, George A., M.D., Sc.D., Emeritus Professor of Anatomy in the University of Pennsylvania. 4724 Chester Ave.

1911. Piersol, George Morris, B.S., M.D., Professor of Medicine and Vice-Dean for Medicine, Graduate School of Medicine, University of Pennsylvania; Physician to the Philadelphia General and Methodist Episcopal Hospitals. 1913 Spruce Street.

1917. Piper, Edmund Brown, B.S., M.D., Associate in Obstetrics, University of Pennsylvania Medical School; Assistant Professor in Obstetrics, University of Pennsylvania Graduate School; Assistant Obstetrician to the University Hospital; Assistant Obstetrician and Gynecologist to the Philadelphia General Hospital. 1936 Spruce St.

1905. Pitfield, Robert L., M.D., Pathologist to the Germantown Hospital; Bacteriologist to the Chestnut Hill Hospital for Lung Diseases. 5211 Wayne Ave.

1922. Pleasants, Henry, Jr., A.B., M.D., Assistant Visiting Physician, Chester County Hospital, West Chester, Pa.; Assistant in Neurological Clinic, Orthopædic Hospital. West Chester, Pa.

1896. Posey, William Campbell, M.D., Ophthalmic Surgeon to the Howard Hospital; Consulting Ophthalmic Surgeon to the Wills Hospital; Chairman of the Commission on the Conservation of Vision for Pennsylvania. 2049 Chestnut Street.

1899. Potts, Charles S., M.D., Professor of Neurology, Graduate School of Medicine, University of Pennsylvania; Neurologist to the Philadelphia General Hospital; Consulting Neurologist, Lankenau Hospital; Consulting Neurologist, Hospital for the Insane, Atlantic County, New Jersey, 2018 Chestnut St.

*1907. Price, George E., M.D. Suite 620, Paulsen Bldg., Spokane, Wash.

ELECTED

1920. Quicksall, William E., M.D. 1819 Spruce St.

1908. Radcliffe, McCluney, A.M. (Lafayette), M.D., LL.D., Consulting Ophthalmologist, Presbyterian Hospital; Attending Surgeon to the Wills Hospital. 1906 Chestnut St.

1913. Randall, Alexander, A.M., M.D., Assistant Professor of Surgery in charge of the Department of Urology, University of Pennsylvania. 1306 Medical Arts Building.

1887. Randall, B. Alex., M.A., M.D., Ph.D., Emeritus Professor of Otology in the University of Pennsylvania; Ear Surgeon to the Children's Hospital; Consulting Aurist to the Pennsylvania Institution for the Deaf and Dumb and to Memorial Hospital, Roxborough. 2009 Spruce St.

*1904. Ravenel, Mazyck P., M.D., Professor of Preventive Medicine and Bacteriology and Director of the Public Health Laboratory at the University of Missouri. 203 Hicks Ave., Columbia, Mo.

1920. Rehfuss, Martin E., M.D. N. E. Cor. 16th and Spruce Sts.

1921. Reiff, E. Paul, A.B., M.D., Member of Medical Staff, Methodist Episcopal Hospital. 5051 Chestnut St.

1919. Reiman, Stanley P., M.D. 516 Arbutus St., Germantown

1923. Repplier, Sidney, J., M.D., Medical Director, Curtis Hospital, Curtis Publishing Company. Chestnut Hill, Phila.

1897. Rhein, John H. W., M.D., Professor of Nervous Diseases, Graduate School of Medicine, University of Pennsylvania; Neuropsychiatrist to the Philadelphia General Hospital; Consulting Neurologist to the Philadelphia Home for Incurables. 1732 Pine St.

1906. Rhein, Robert D., M.D., Chief Physician to the Clinic of the American Hospital for Diseases of the Stomach; Physician to the Philadelphia Home for Incurables; Examining Physician to the White Haven Sanatorium. S. W. Cor. 15th and Pine Sts.

1891. Rhoads, Edward G. M.D., New Hope, Pa.

*1910. Rhoads, Samuel, M.D. Altadena, Calif.

1919. Richardson, Russell, A.M., M.D., Director of the Laboratory, Methodist Episcopal Hospital; Pathologist to Abington Memorial Hospital and the Associated Medical Clinics. 320 S. Sixteenth St.

1919. Ridpath, Robert F., M.D. 1928 Chestnut St.

1898. Riesman, David, M.D., Professor of Clinical Medicine, University of Pennsylvania; Visiting Physician to the Phila-

ELECTED

delphia General and University Hospitals; Consulting Physician to the Jewish and Woman's Hospitals. 1520 Spruce St.

1895. Ring, G. Oram, A.M., M.D., Ophthalmic Surgeon to the Episcopal Hospital; Ophthalmologist to the Widener Memorial Home for Crippled Children; Consulting Ophthalmologist to the American Oncologic Hospital. N. E. Cor. Seventeenth and Walnut Sts.

‡1905. Risley, J. Norman, M.D. New Bedford, Mass.

‡1878. Roberts, John B., A.M., M.D., Professor of Surgery, Graduate School of Medicine, University of Pennsylvania. 1520 Spruce St.

1899. Roberts, Walter, M.D., Professor of Otology in the Philadelphia Polyclinic; Otologist to the Methodist Episcopal Hospital; Laryngologist to the Philadelphia General Hospital. 1732 Spruce St.

1903. Robertson, William Egbert, M.D., Professor of Theory and Practice of Medicine and of Clinical Medicine in Temple University; Physician to the Episcopal, Samaritan and Garretson Hospitals. 327 S. Seventeenth St.

1903. Robinson, William Duffield, Ph.G., M.D. 2012 Mount Vernon St.

1912. Rodman, John Stewart, M.D., Lecturer on Surgery in the Medico-Chirurgical College; Assistant Surgeon to the Medico-Chirurgical Hospital; Assistant Surgeon to the Presbyterian Hospital; Assistant Surgeon to the Outpatient Department of the Pennsylvania Hospital. 1310 Medical Arts Building.

1909. Rosenberger, Randle C., M.D., Professor of Preventive Medicine and Bacteriology in the Jefferson Medical College. 2330 N. Thirteenth St.

*1907. Royer, B. Franklin, M.D., American Child Health Association. Tunkhannock, Pa.

†1905. Rugh, James Torrance, A.B., M.D., Clinical Professor of Orthopedic Surgery in the Woman's Medical College of Pennsylvania; Orthopedic Surgeon to the Jefferson Medical College; Orthopedic Surgeon to the Methodist and the Philadelphia General Hospitals. 1616 Spruce St.

1897. Sailer, Joseph, Ph.B., M.D., Professor of Clinical Medicine in University of Pennsylvania; Physician to the Philadelphia General, the University, and Presbyterian Hospitals. 250 S. Eighteenth St.

ELECTED

1900. Sajous, Charles E. de M., M.D., LL.D., Sc.D., Officer of the Legion of Honor of France and of the Order of Leopold of Belgium; Professor of Endocrinology, Graduate School of Medicine, University of Pennsylvania; Emeritus Professor of Therapeutics in Temple University Medical School. 2043 Walnut St.

1905. Sartain, Paul J., A.M., M.D. 2006 Walnut St.

1908. Sautter, Albert C., M.D., Assistant in the Dispensary for Diseases of the Eye in the University Hospital; Assistant in the Eye Dispensary of the Lankenau Hospital. 1421 Locust St.

1906. Saylor, Edwin S., M.D., Chief Ophthalmologist to the Diagnostic Hospital of Philadelphia. 2100 Chestnut St.

1920. Scarlett, Hunter W., M.D. 230 S. Twenty-first St.

*1910. Scarlett, Rufus B., M.D., Laryngologist to the Home for Consumptives at Chestnut Hill; Assistant in the Department for Diseases of the Ear, Throat, and Nose of the Pennsylvania Hospital; Instructor in Diseases of the Nose and Throat in the Philadelphia Polyclinic and College for Graduates in Medicine. 78 N. Clinton Ave., Trenton, N. J.

1917. Schaeffer, Jacob Parsons, A.M., M.D., Ph.D., Professor of General Anatomy and Director of the Daniel Baugh Institute of Anatomy of the Jefferson Medical College. 4634 Spruce St.

1899. Schamberg, Jay F., M.D., Professor of Dermatology and Syphilology, Graduate School of Medicine, University of Pennsylvania; Director, Research Institute of Cutaneous Medicine. 1402 Spruce St.

1917. Schnabel, Truman Gross, A.B. (Lehigh), M.D., Associate in Medicine, University of Pennsylvania; Assistant Physician, Philadelphia General Hospital; Physician in the Medical Out-patient Department, University Hospital. 1704 Pine Street.

1917. Schoff, Charles H., M.D. Media, Pa.

1921. Schumann, Edward Armin, A.B., M.D., Obstetrician and Gynecologist, Philadelphia General Hospital; Gynecologist, Frankford Hospital; Lecturer on Obstetrics, Jefferson Medical College; Consulting Gynecologist, Rush Hospital. 1814 Spruce St.

1887. de Schweinitz, George Edmund, A.M., M.D., LL.D., Professor of Ophthalmology in the University of Pennsyl-

ELECTED

vania; Consulting Ophthalmic Surgeon to the Orthopædic Hospital and Infirmary for Nervous Diseases, The Philadelphia Polyclinic and School for Graduates in Medicine, and the Philadelphia General Hospital; Ophthalmic Surgeon to the University Hospital. 1705 Walnut St.

*1913. de Schweinitz, George Lord, B.S., M.D., Assistant in the Department of Ophthalmology, St. Luke's Hospital, Bethlehem, Pa. 85 East Broad St., Bethlehem, Pa.

1910. Schwenk, Peter N. K., M.A., M.D., Attending Surgeon to the Eye Department of the Pennsylvania Hospital; Attending Surgeon to the Wills Hospital. 1417 N. Broad Street.

1917. Service, Charles A., M.D. Bala, Pa.

1924. Shallow, Thomas A., M.D. 3942 Chestnut St.

1908. Shannon, Charles E. G., A.B., M.D., Instructor in Ophthalmology in the Jefferson Medical College; Assistant in the Ophthalmological Clinic at the Jefferson Medical College Hospital; Ophthalmologist to the Seybert Institution. N. E. Corner Seventeenth and Walnut Sts.

1897. Sharpless, William T., M.D., Physician to the Chester County Hospital. West Chester, Pa.

1906. Shields, William G., M.D., Dermatologist to Germantown Hospital; Chief of Dermatological Clinic and Assistant Physician to the Jewish Hospital. 414 School Lane, Germantown.

*1908. Shoemaker, Harlan, A.B., M.D., Lecturer in Surgery, University of Southern California; Surgeon to Los Angeles County Hospital; Surgeon to Washington Street Clinic. 521 Bank of Italy Building, Los Angeles, Calif.

†1893. Shoemaker, Harvey, M.D., Visiting Physician to the Sheltering Arms; Consulting Physician to the Southern Home for Destitute Children; Assistant Physician to the Lankenau Hospital; Physician to the Out-patient Department of the Lankenau Hospital. 1727 Spruce St.

†1896. Shoemaker, William T., M.D., Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Clinical Professor of Ophthalmology in the Woman's Medical College of Pennsylvania; Ophthalmic Surgeon to Lankenau, Germantown and Pennsylvania Hospitals. 109 S. Twentieth St.

1900. Shumway, Edward Adams, B.S., M.D., Ophthalmic Surgeon to the Philadelphia General, Lankenau and Children's

ELECTED

Hospitals; Assistant Professor of Ophthalmology in the University of Pennsylvania, and Assistant Ophthalmic Surgeon to the University Hospital. 2046 Chestnut St.

1903. SINCLAIR, JOHN FALCONER, M.D., Epidemilogist, Presbyterian Hospital; Physician to the Philadelphia Orphan Asylum and to the Presbyterian Orphanage; Physician to the Home of the Merciful Saviour for Crippled Children. 4103 Walnut St.

1907. SINKLER, FRANCIS WHARTON, A.B., M.D., Physician to the Orthopædic Hospital and Infirmary for Nervous Diseases. 1606 Walnut St.

1902. SITER, E. HOLLINGSWORTH, M.D., Genito-urinary Surgeon to the Philadelphia General Hospital. 512 Medical Arts Building.

1904. SKILLERN, PENN-GASKELL, M.D. 1633 Locust St.

1920. SKILLERN, ROSS HALL, M.D., Professor of Laryngology, Graduate School of Medicine, University of Pennsylvania; Laryngologist to Medico-Chirurgical Hospital. 1928 Chestnut St.

1904. SMITH, ALLEN J., A.M., M.D., Sc.D. (Penna. Coll.), LL.D. (McGill Univ.), Professor of Pathology and of Comparative Pathology and Director of Courses in Tropical Medicine in the University of Pennsylvania. Medical Laboratories, University of Pennsylvania.

1905. SMITH, S. MACCUEN, M.D., Professor of Otology in the Jefferson Medical College; Aurist and Laryngologist to the Germantown Hospital; Aurist to the Jewish Hospital; Consulting Aurist to the Memorial Hospital, Roxborough, and to the Oncologic Hospital. 1429 Spruce St.

1919. SMYTH, HENRY FIELD, M.D. Wayne, Pa.

1908. SPEESE, JOHN, M.D., Assistant Professor, Surgical Pathology, University of Pennsylvania; Associate Professor in Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon to the Children's and Presbyterian Hospitals. 1832 Spruce St.

1895. SPELLISSY, JOSEPH M., A.M., M.D., Visiting Surgeon to St. Joseph's and to the Methodist Episcopal Hospitals; Assistant Surgeon to the Orthopedic Department of the University Hospital. 317 S. Fifteenth St.

1897. SPILLER, WILLIAM G., M.D., Professor of Neurology in the University of Pennsylvania; Clinical Professor of Nervous Diseases in the Woman's Medical College of Pennsylvania;

ELECTED

Neurologist to the Philadelphia General Hospital. 4409 Pine St.

1894. STAHL, B. FRANKLIN, B.S., Ph.G., M.D., Visiting Physician to St. Agnes' and the Philadelphia General Hospitals. 1727 Pine St.

1909. STARBUCK, J. CLINTON, M.D., Physician to the Orphanage, Orphan Society of Philadelphia at Wallingford and to the Glen Mills School, Glen Mills, Pa. 42 E. Washington St., Media, Pa.

*1875. STARR, LOUIS, M.D., LL.D. (Haverford). Care of Brown, Shipley & Co., London, England.

1912. STAUFFER, NATHAN PENNYPACKER, D.D.S., M.D., Laryngologist and Otologist to the Presbyterian Hospital; to the Philadelphia General Hospital, Tubercular Department; to the Home for Crippled Children. 2015 Walnut St.

1910. STELLWAGEN, THOMAS C., JR., M.D., Chief Clinical Assistant in the Out-patient Surgical Department of the Jefferson Medical College Hospital. 1912 Pine St.

1895. STENGEL, ALFRED, M.D., Sc.D., Professor of Medicine in the University of Pennsylvania; Physician to the University Hospital and the Pennsylvania Hospital. 1728 Spruce St.

1901. STEVENS, ARTHUR A., M.D., Professor of Materia Medica, Therapeutics and Clinical Medicine in the Woman's Medical College of Pennsylvania; Lecturer on Physical Diagnosis in the University of Pennsylvania; Physician to the Episcopal and St. Agnes' Hospitals. 314 S. Sixteenth Street.

1914. STEWART, THOMAS S., B.S. (Univ. of Penna.), M.D. 301 S. Eighteenth St.

1921 STONER, WILLIAM H., A.B., A.M., Pharm. D., M.D., Associate Professor of Biochemistry, Graduate School of Medicine, University of Pennsylvania; Assistant Metabolic Physician, Philadelphia General Hospital. Medical Laboratories, Univerysity of Pennsylvania.

1898. STOUT, GEORGE C., M.D., Consulting Laryngologist and Aurist to the Presbyterian Hospital, the Children's Aid Society and the William Penn Charter School. 2015 Walnut St.

1923. STRECKER, EDWARD, A., A.M., M.D., Medical Director of Department for Mental and Nervous Diseases and Neurologist to Pennsylvania Hospital and Chief of the Out-patient Neuro-psychiatric Clinic; Neurologist, Misericordia Hospital;

ELECTED

Assistant Professor of Psychiatry, Graduate School of Medicine, University of Pennsylvania. 4401 Market St.

1923. STROUD, WILLIAM D., M.D. 1011 Clinton St.

1923. STROUSE, FREDERICK M., M.D. 1301 Spruce St.

1884. STRYKER, SAMUEL S., M.D., Consulting Physician to the Presbyterian Hospital. 3833 Walnut St.

*1900. SWAN, JOHN M., M.D., Attending Physician, Park Avenue Clinical Hospital. 457 Park Avenue, Rochester, New York.

1898. SWEET, WILLIAM M., M.D., Clinical Professor of Ophthalmology in the Jefferson Medical College, and Ophthalmic Surgeon to the Jefferson Medical College Hospital; Consulting Surgeon to the Wills Hospital. 1205 Spruce Street.

1900. TALLEY, JAMES ELY, A.B., M.D., Professor of Cardiology, Graduate School of Medicine, University of Pennsylvania; Physician to the Presbyterian and Methodist Episcopal Hospitals. 1811 Spruce St.

1886. TAYLOR, JOHN MADISON, A.B. and A.M. (Princeton), M.D., Professor of Physical Therapeutics and Diatetics, Medical Department Temple University. 1504 Pine St.

1887. TAYLOR, WILLIAM J., M.D., Surgeon to the Orthopædic Hospital and Infirmary for Nervous Diseases, and to St. Agnes' Hospital; Consulting Surgeon to the West Philadelphia Hospital for Women. 1825 Pine St.

1886. TAYLOR, WILLIAM L., M.D. 2223 Tioga St.

†1910. THOMAS, BENJAMIN A., A.B., A.M., M.D., Vice-Dean and Professor of Urology, Graduate School of Medicine, University of Pennsylvania; Genito-urinary Surgeon, Presbyterian Hospital; Consulting Genito-urinary Surgeon, Pennsylvania Railroad and to the Prison, Philadelphia. 116 S. Nineteenth St.

1912. THOMAS, FRANK WISTER, A.M., M.D., Visiting Physician to "Buttercup Cottage;" Consulting Physician to the Germantown Hospital. 27 E. Mt. Airy Ave.

1907. THOMAS, THOMAS TURNER, M.D., Associate Professor of Applied Anatomy and Associate in Surgery in the University of Pennsylvania; Surgeon to the Philadelphia General Hospital; Assistant Surgeon to the University Hospital. 2009 Spruce St.

1896. THORINGTON, JAMES, A.M., M.D., Consulting Ophthalmic Surgeon to the Presbyterian Hospital; Ophthalmologist to

ELECTED

the Ellwyn, Pa., Training School for Feeble-minded Children. 2031 Chestnut St.

1898. THORNTON, EDWARD Q., M.D., Assistant Professor of Materia Medica in the Jefferson Medical College. 1331 Pine St.

1912. TORREY, ROBERT G., M.D., Assistant Physician to the Philadelphia General Hospital; Physician to the State Tuberculosis Dispensary. 1716 Locust St.

1896. TOULMIN, HARRY, M.D., Vice-President, Medical Department, Penn Mutual Life Insurance Company. Haverford, Pa.

1908. TRACY, STEPHEN E., M.D., Gynecologist to the Stetson Hospital; Visiting Surgeon to the Gynecean Hospital. 1527 Spruce St.

*1901. TUCKER, HENRY, M.D. Bellevue, Md.

†1894. TUNIS, JOSEPH PRICE, M.D., Assistant Professor of Histology and Embryology, Temple University. Chestnut Hill, Philadelphia.

1924. TURNER, CHARLES ROOT, A.B., D.D.S., M.D., Dean, School of Dentistry, University of Pennsylvania. Merion, Pa.

1923. TURNER, CREIGHTON H., M.D., Associate in Medicine, Jefferson Medical College; Visiting Physician, St. Agnes' Hospital. Medical Arts Building.

1901. TURNER, JOHN B., M.D., Ph.D., Assistant in the Ophthalmological Clinic, Methodist Episcopal Hospital. 1833 Chestnut St.

1897. TYSON, T. MELLOR, M.D., Physician to the Philadelphia General Hospital; Physician to the Rush Hospital, the Philadelphia Lying-in-Charity Hospital and the Children's Aid Society of Philadelphia. 1506 Spruce St.

1907. ULLOM, JOSEPHUS TUCKER, M.A., M.D., Physician to the Chestnut Hill Hospital. Carpenter and Quincy Streets, Germantown.

*1913. VAIL, WILLIAM PENN, B.S., M.S., M.D., Laryngologist to the Pennsylvania Institution for the Instruction of the Blind; Laryngologist to the Department for Tuberculosis of the Philadelphia General Hospital; Assistant Laryngologist and Otologist to the Out-patient Department of the Pennsylvania Hospital; Assistant Laryngologist to the Children's Hospital. Blairstown, N. J.

°1873. VAN HARLINGEN, ARTHUR, Ph.B. (Yale), M.D., Emeritus Professor of Diseases of the Skin in the Philadelphia Polyclinic. 1831 Chestnut St.

ELECTED

1903. Van Pelt, William Turner, M.D. Chestnut Hill, Philadelphia.

1893. Vansant, Eugene Larue, M.D. 2046 Chestnut St.

1912. Vaux, Norris Wistar, M.D., Surgeon to the Chestnut Hill Hospital; Surgeon to the Dispensary of the Germantown Hospital. 1810 S. Rittenhouse Square.

*1897. Veasey, Clarence A., A.M., M.D. Suite 404, Paulsen Building, Spokane, Wash.

†1883. Vinton, Charles Harrod, A.M., M.D. P. O. Box 464, Atlantic City, N. J.

1903. Wadsworth, William Scott, M.D. 3914 Baltimore Ave.

1906. Walker, John K., M.D., Physician to the Children's Hospital of the Mary J. Drexel Home; Physician to the Out-patient Department of the Pennsylvania Hospital. 1819 De Lancey St.

1907. Walker, Warren, M.D., Dermatologist to the Episcopal and Bryn Mawr Hospitals. 1819 Chestnut St.

1904. Walsh, Joseph, A.M., M.D., Visiting Physician to and Medical Director of the White Haven Sanatorium. Medical Arts Building.

1910. Ward, E. Tillson, A.M., M.D. 2006 Mt. Vernon St.

1895. Watson, Arthur W., M.D., Professor of Diseases of the Throat and Nose in the Philadelphia Polyclinic and College for Graduates in Medicine; Laryngologist to the Jewish Hospital; Laryngologist and Aurist to the Mt. Sinai Hospital; Laryngologist to Home for Incurables. 2013 Locust St.

1886. Watson, Edward W., M.D., Physician to the Magdalene Home. 38 S. Nineteenth St.

1923. Watson, William R., M.D., Chief Laryngologist, Episcopal and Diagnostic Hospitals; Assistant Chief Laryngologist, Pennsylvania Hospital. 2124 Pine St.

1903. Weber, Charles H., M.D., Associate in Pediatrics, Graduate School of Medicine, University of Pennsylvania; Physician to the Medical Dispensary, Children's Hospital; Pediatrist, Howard Hospital and to the Municipal Court. 1811 Spruce Street.

1920. Weidman, Fred. D., M.D., Assistant Director, Laboratory of Dermatological Research, University of Pennsylvania; Assistant Pathologist, Philadelphia Zoölogical Garden and University Hospital. 20 Tenby Road, Llanerch, Pa.

ELECTED

1906. Weisenburg, Theodore H., M.D., Professor of Neuro-Psychiatry, Graduate School of Medicine, University of Pennsylvania; Neurologist, Philadelphia General Hospital and Physician to Orthopædic Hospital and Infirmary for Nervous Diseases. 2037 DeLancey St.

1923. Weiss, Edward, M.D., Demonstrator of Clinical Medicine, Jefferson Medical College; Assistant Attending Physician, Jewish Hospital and in the Tuberculosis Wards, Philadelphia General Hospital. 1906 Walnut St.

1913. Wells, P. Frailey, A.M., M.D., Ph.D., 754 N. Fortieth St.

1893. Westcott, Thompson S., M.D., Associate in Diseases of Children in the University of Pennsylvania; Pediatrist to the Methodist Episcopal Hospital; Consulting Physician, Haddock Memorial Home. 1720 Pine St.

1884. Wharton, Henry R., M.D., Consulting Surgeon to the Presbyterian and the Children's Hospitals; Surgeon to Girard College; Consulting Surgeon to the Bryn Mawr Hospital, the Chestnut Hill Hospital, St. Christopher's Hospital for Children, the Pennsylvania Institution for the Deaf and Dumb, and the Pennsylvania Institution for the Blind. Berwyn, Pa.

1921. Whitaker, William, M.D., Surgeon to Dispensary of the Episcopal Hospital. 5448 Germantown Ave.

1901. White, Courtland Y., M.D., Director of the Pathological Laboratories of the Episcopal Hospital; Pathologist to the Children's Hospital and to the Kensington Hospital for Women; Chief Bacteriologist to the Bureau of Health, Department of Health and Charities, Philadelphia. 6611 N. Tenth St.

*1905. Whiteway, Harold M., M.D. 2356 W. Twenty-first St., Los Angeles, Calif.

1898. Whiting, Albert D., M.D., Associate Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Associate Surgeon, Lankenau Hospital; Surgeon, Germantown Hospital. 1523 Spruce St.

1914. Willard, de Forest P., B.S. (Univ. of Penna.), M.D., Professor of Orthopædics, Graduate School of Medicine, University of Pennsylvania; Orthopædic Surgeon to the Polyclinic, Jewish and Delaware Hospitals. 1630 Spruce St.

1907. Williams, Carl, B.S., M.D., Ophthalmic Surgeon to the Germantown Hospital; Instructor in Ophthalmology in

ELECTED

the University of Pennsylvania; Ophthalmic Surgeon to the Pennsylvania Institution for the Deaf and Dumb. School Lane and Greene Sts., Germantown.

1924. WILLIAMS, HORACE JAMES, M.D. 5908 Greene St. Germantown.

1920. WILLIAMS, PHILIP F., Ph.B., M.D., Assistant Professor of Obstetrics, Graduate School of Medicine, University of Pennsylvania; Instructor in Obstetrics, School of Medicine, University of Pennsylvania; Obstetrician to the Maternity Hospital of Philadelphia and Assistant Gynecologist to the Presbyterian Hospital. 2206 Locust St.

1916. WILMER, HARRY B., M.D., Assistant Instructor in Medicine, University of Pennsylvania: Assistant Visiting Physician and Assistant Neurologist to the Germantown Hospital; Visiting Chief to the Dispensary of the Germantown Hospital. 138 W. Walnut Lane, Germantown.

1921. WILSON, GEORGE, M.D., Instructor in Medicine and Neurology, School of Medicine, University of Pennsylvania; Assistant Physician, Philadelphia Hospital; Assistant Neurologist, Philadelphia, University and Children's Hospitals; Consulting Neurologist, St. Christopher's Hospital and the Pennsylvania Training School for Feeble-minded Children. N. E. Cor. Twentieth and Chestnut Sts.

1874. WILSON, JAMES CORNELIUS, A.M. (Princeton), M.D., Emeritus Professor of the Practice of Medicine and of Clinical Medicine in the Jefferson Medical College; Physician-in-Chief to the Lankenau Hospital; Emeritus Physician to the Pennsylvania Hospital; Consulting Physician to the Bryn Mawr Hospital. 1509 Walnut St.

1902. WILSON, SAMUEL M., M.D. 2018 Chestnut St.

1897. WILSON, W. REYNOLDS, M.D. Villa Nova, Pa.

1904. WISTER, JAMES W., M.D., Physician to the Out-patient Department of the Germantown Hospital. 5430 Germantown Ave.

*1901. WITMER, A. FERREE, M.D. Freeport, Long Island, N. Y.

1918. WOLFERTH, CHARLES CHRISTIAN, A.B., M.D., Associate in Medicine, University of Pennsylvania; Associate in Cardiac Pathology, William Pepper Laboratory of Clinical Medicine, University of Pennsylvania. 1704 Pine St.

1893. WOOD, ALFRED C., M.D., Assistant Professor of Surgery in the University of Pennsylvania; Surgeon to the University,

ELECTED

the Philadelphia General, St. Timothy's and the Howard Hospitals. 2035 Walnut St.

1900. Wood, George, B., M.D., Laryngologist and Otologist, Orthopædic and Howard Hospitals; Professor of Laryngology, Graduate School, University of Pennsylvania. N. E. Cor. Twentieth and Chestnut Sts.

1903. Wood, Horatio C., Jr., M.D., Professor of Pharmacology and Therapeutics in the University of Pennsylvania; Professor of Materia Medica, Philadelphia College of Pharmacy and Science. 319 S. Forty-first St.

°1880. Woodbury, Frank, M.D., Secretary to the Committee on Lunacy of the Board of Charities of Pennsylvania. 101 Allen Lane, Mt. Airy.

*1911. Woods, Andrew H., A.B., M.D., Professor and Head of the Neurological Department, Peking Union Medical College, Peking, China.

†1897. Woodward, George, M.D. W. Willow Grove Ave., Chestnut Hill, Philadelphia.

‡1913. Woodward, W. Wellington, M.D. 26 S. Church St., West Chester, Pa.

1903. Worden, Charles B., A.M., M.D. Princeton, N. J.

1894. Zentmayer, William, M.D., Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Attending Surgeon to the Wills Hospital; Ophthalmologist to the Glen Mills School. 1506 Spruce St.

1899. Ziegler, S. Lewis, A.M., M.D., LL.D., Attending Surgeon to the Wills Hospital; Chief Ophthalmic Surgeon to St. Joseph's Hospital; Membre Société Française d'Ophthalmologie. 1625 Walnut St.

1887. Ziegler, Walter M. L., A.M., M.D. 1418 N. Seventeenth St.

1895. Zimmerman, Mason W., M.D., Consulting Ophthalmic Surgeon to the Germantown Hospital. 1518 Waverly St.

ASSOCIATE FELLOWS

(Limited to Fifty, of whom Twenty may be Foreigners)

American

ELECTED

1911. Abbe, Robert, M.D. 40 W. Fifty-ninth St., New York City, New York.

1909. Billings, Frank, M.D., 1550 North State Parkway, Chicago, Illinois.

1893. Councilman, William T., M.D., Harvard Medical College, Boston, Massachusetts.

1909. Crile, George W., M.D., 1021 Prospect Avenue, S. E., Cleveland, Ohio.

1909. Dana, Charles Loomis, M.D., 53 West Fifty-third Street, New York City, New York.

1892. Emmet, Thomas Addis, M.D., 91 Madison Avenue, New York City, New York.

1912. McCaw, Brig.-Gen. Walter D., M.D. Assistant Surgeon-General, U. S. A., Army Medical School, Washington, D. C.

1906. Mayo, William J., M.D., Rochester, Minnesota.

1906. Pilcher, Lewis Stephen, M.D., 145 Gates Avenue, Brooklyn, New York.

1906. Shattuck, Frederick C., M.D., 135 Marlborough Street, Boston, Massachusetts.

1894. Warren, J. Collins, M.D., 58 Beacon Street, Boston, Massachusetts.

1894. Weir, Robert F., M.D., 16 East Ninety-sixth St., New York City, New York.

1892. Welch, William H., M.D., Johns Hopkins Hospital, Baltimore, Maryland.

Foreign

1890. Baccelli, Guido, Rome, Italy.
1908. Bannerman, W. B., M.D., General, I. M. S., 11 Strathearn Place, Edinburgh, Scotland.
1924. Hopkins, F. Gowland, M.D., Cambridge, England.
1909. Macallum, Archibald B., M.A., M.B., Ph.D., Sc.D., LL.D., F.R.S., Department of Biochemistry, McGill University, Montreal, Canada.
1922. McCarrison, Lieut.-Col., Robert, M.D. (London), D.Sc. (Oxford, Eng.), LL.D., C. I. E., The Neuk, Silverdale Road, Eastbourne, England.
1924. Macleod, John James R., M.D., Toronto, Canada.
1906. Myles, Sir Thomas, M.D., 33 Merion Square, W., Dublin, Ireland.
1908. Ross, Col. Sir Ronald, K.C.B., K.C.M.G., F.R.S., M.D., D.Sc., LL.D., 36 Harley House, London, N. W. I., England.

CORRESPONDING MEMBERS

1880. Carrow, Flemming, M.D., 823 David Whitney Building, Detroit, Mich.
1885. Rendu, Jean, M.D., Lyons, France.
1916. Estes, William Lawrence, M.D., South Bethlehem, Pa.
1916. Guitéras, John, M.D., Benavides, Cuba.
1917. Miner, Charles H., M.D., Wilkes-Barre, Pa.

NECROLOGICAL LIST

FELLOWS

W. WALLINGTON WOODWARD, M.D.	January	13, 1924
HENRY D. BEYEA, M.D.	January	19, 1924
ALBERT P. FRANCINE, M.D.	March	17, 1924
MACY BROOKS, M.D.	June	4, 1924
DUNCAN L. DESPARD, M.D.	August	5, 1924
ROBERT G. LE CONTE, M.D.	August	6, 1924
GEORGE A. PIERSOL, M.D.	August	7, 1924
MORRIS BOOTH MILLER, M.D.	November	5, 1924
ALEXANDER W. MacCOY, M.D.	November	19, 1924
JOHN B. ROBERTS, M.D.	November	28, 1924
DAVID GREGG METHENY, M.D.	December	15, 1924
J. NORMAN RISLEY, M.D.	December	17, 1924
JAMES V. INGHAM, M.D.	December	29, 1924

LIST OF PRIZES AND LECTURES

THE WILLIAM F. JENKS MEMORIAL PRIZE

(Triennial)

1889	John Strahan, M.D.	Belfast (Ireland).
1895	Abram Brothers, M.D.	New York.

NOTE—June 12, 1900, the William F. Jenks Memorial Prize Fund was transferred to the Library as the "William F. Jenks Memorial Library Fund."

ALVARENGA PRIZE OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA

(Annual)

1890	R. W. Philip, M.D.	Edinburgh (Scotland).
1891	L. Duncan Bulkley, M.D.	New York.
1892	R. H. L. Bibb, M.D.	Saltillo.
1894	G. E. de Schweinitz, M.D.	Philadelphia.
1895	Guy Hinsdale, M.D.	Philadelphia.
1897	Joseph Collins, M.D.	New York.
1898	S. A. Knopf, M.D.	New York.
1898	Robert Randolph, M.D.	Baltimore.
1900	David de Beck, M.D.	Cincinnati.
1901	George W. Crile, M.D.	Cleveland.
1903	William S. Carter, M.D.	Galveston.
1905	D. Chalmers Watson, M.D.	Edinburgh (Scotland).
1907	William Louis Chapman, M.D.	Providence.
1908	William T. Shoemaker, M.D.	Philadelphia.
1910	M. Katzenstein, M.D.	Berlin (Germany).
1911	Francis D. Patterson, M.D.	Philadelphia.
1914	H. B. Sheffield, M.D.	New York.
1915	J. E. Sweet, M.D.	Philadelphia.
1917	Wilburt C. Davison, M.D.	Baltimore.
1921	John W. Churchman, M.D.	New York.
1923	Edward P. Heller, M.D.	Kansas City, Mo.
1924	Gordon Cameron, M.B., B.S.	Victoria, Australia.

NATHAN LEWIS HATFIELD PRIZE FOR ORIGINAL RESEARCH IN MEDICINE

(Triennial)

1901	Henry F. Harris, M.D.	Atlanta.
1909	Martin Henry Fischer, M.D.	Oakland.
1917	A. B. Macallum, M.D., F.R.S.	Toronto.
1919	Harvey Cushing, M.D.	Boston.
1921	William R. Nicholson, M.D.	Philadelphia.
1922	Sir Thomas Lewis, C.B.E., M.D., F.R.S.	London (Eng.).
1923	Frederick Grant Banting, M.D.,	Toronto.
1924	George J. Heuer, M.D.	Cincinnati.

NOTE.—November 29, 1913, by Supplemental Deed of Trust, the title of this Fund was changed to "Nathan Lewis Hatfield Prize and Lectureship."

WEIR MITCHELL LECTURES

Jan. 17, 1911	Arthur R. Cushny, M.D.	London.
Mar. 30, 1911	Edmund B. Wilson, Ph.D., LL.D.	New York.
May 16, 1911	Svante Arrhenius	Stockholm.
Nov. 3, 1911	William T. Porter, M.D.	Boston.
Mar. 29, 1912	William H. Howell, M.D.	Baltimore.
Oct. 21, 1912	G. H. F. Nuttall, F.R.S., M.D.	Cambridge (Eng.).
April 4, 1913	H. P. Armsby, Ph.D., LL.D.	Pennsylvania.
Feb. 25, 1914	Harvey Cushing, M.D.	Boston.

PUBLIC LECTURES

Feb. 16, 1910	S. Weir Mitchell, M.D.	Philadelphia.
Nov. 17, 1910	Simon Flexner, M.D.	New York.
Dec. 15, 1910	William H. Welch, M.D.	Baltimore.
April 18, 1911	James G. Mumford, M.D.	Clifton Springs, N.Y.
Nov. 20, 1911	Talcott Williams, A.M., LL.D., Litt.D.	Philadelphia.
April 29, 1912	Owen Wister, A.M., LL.D.	Philadelphia.
Feb. 17, 1913	John K. Mitchell, M.D.	Philadelphia.
Feb. 15, 1916	Daniel J. McCarthy, M.D. and Walter Estell Lee, M.D.	Philadelphia.
April 15, 1916	Surgeon A. M. Fauntleroy	U. S. Navy.

MARY SCOTT NEWBOLD LECTURES

Mar. 29, 1917	A. T. McCormack, M.D.	Bowling Green, Ky.
April 4, 1919	Col. Thomas W. Salmon, M.C.,	U. S. Army.
Feb. 6, 1920	Alonzo E. Taylor, M.D.	Philadelphia.
Feb. 4, 1921	Maj.-Gen. Merritte W. Ireland	Washington.
April 20, 1921	Prof. William Romaine Newbold,	Philadelphia.
Nov. 11, 1921	Robert McCarrison, M.D., D.Sc., LL.D.	Oxford (Eng.).
Feb. 1, 1922	Hans Zinsser, M.D.	New York.
April 5, 1922	G. Canby Robinson, M.D.	Baltimore.
Dec. 6, 1922	Donald C. Balfour, M.D.	Rochester, Minn.
Mar. 7, 1923	J. J. R. Macleod, M.D.	Toronto.
April 4, 1923	Prof. Leon Asher, M.D.	Berne (Switzerl'd).
Mar. 5, 1924	Prof. A Biedl	Prague (Czecho-Slovakia).
April 15, 1924	J. G. FitzGerald, M.D.	Toronto.
Oct. 31, 1924	John I. Hunter, M.D., and N. D. Royle, M.D.	Sydney (Australia).
Dec. 4, 1924	Willem Einthoven, M.D.	Leyden (Holland).

MÜTTER LECTURES

1865	J. H. Packard, M.D.	Philadelphia.
1866	J. H. Packard, M.D.	Philadelphia.
1867	J. H. Packard, M.D.	Philadelphia.
1868	Harrison Allen, M.D.	Philadelphia.
1869	J. H. Brinton, M.D.	Philadelphia.
1872	J. da S. Solis Cohen, M.D.	Philadelphia.
1879	S. W. Gross, M.D.	Philadelphia.
1882	E. O. Shakespeare, M.D.	Philadelphia.
1885	H. F. Formad, M.D.	Philadelphia.
1888	O. H. Allis, M.D.	Philadelphia.
1890–1891	Roswell Park, M.D.	Buffalo.
1893–1894	De Forrest Willard, M.D., and Guy Hinsdale, M.D.	Philadelphia.
1896	O. H. Allis, M.D.	Philadelphia.
1899–1900	J. B. Roberts, M.D.	Philadelphia.
1901	H. W. Cushing, M. D.	Boston.
1902	L. A. La Garde, M.D.	Washington.
1903	C. N. B. Camac, M.D.	New York.
1904	G. H. Monks, M.D.	Boston.
1905	A. O. J. Kelly, M.D.	Philadelphia.

1906	W. J. Mayo, M.D.	Rochester, Minn
1907	J. Rogers, M.D., and S. P. Beebe, M.D.	New York.
1908	G. W. Crile, M.D.	Cleveland.
1909	H. D. Fry, M.D,	Washington.
1910	T. W. Hastings, M.D.	New York.
1911	C. F. Nassau, M.D.	Philadelphia.
1912	J. C. Bloodgood, M.D.	Baltimore.
1913	R. C. Coffey, M.D.	Portland, Ore.
1914	F. H. Albee, M.D.	New York.
1915–1916	Rudolph Matas, M.D.	New Orleans, La.
1916	Nelson M. Percy, M.D.	Chicago, Ill.
1917	Chevalier Jackson, M.D.	Philadelphia.
1919	Alexis V. Moschcowitz, M.D.	New York.
1920	J. Chalmers Da Costa, M.D.	Philadelphia.
1921	Prof. H. C. Jacobaeus	Stockholm (Swed.).
1922	James Ewing, M.D.	New York.
1923	J. Edwin Sweet, M.D.	Philadelphia.
1924	Evarts Graham, M.D.	St. Louis.

WEIR MITCHELL ORATION

1919	Charles W. Burr, M.D.	Philadelphia.
1922	Charles Loomis Dana, M.D	New York.

MEMOIR OF J. CHESTON MORRIS, M.D.[1]

By ELLISTON J. MORRIS, M.D.

No custom of the College is more beautiful than this, when we pause for a moment while we recall memories of some Fellow no longer present.

It is a pleasure to me to bring to your minds tonight Dr. James Cheston Morris—elected a Fellow in 1856, and, at the time of his death, the oldest Fellow of the College as well as the oldest graduate of the University of Pennsylvania.

He was endeared to me through kinship and association. He was my uncle and my preceptor, in the days when medical students had preceptors, and were all the better for it.

Dr. Morris was the son of Caspar Morris, M.D. (long a Fellow of the College), who, in 1829, had married Anne Cheston, the daughter of James Cheston, a merchant of Baltimore. Dr. Caspar Morris brought his bride to live in Chestnut Street below Broad Street—about where the western end of the Widener Building now stands—and the good people of that day said that he was a perfect heathen to take a young and pretty woman, like his wife, so far out of the city to live. Here, James Cheston Morris was born on May 28, 1831.

The vacation days of his boyhood were pleasantly spent at either "Green Hill," the home of his father's father, Israel Wistar Morris, on City Line, near the Lancaster Pike, or at "Ivy Neck," a farm on the western shore of the Chesapeake below Annapolis, which his mother had inherited from her father, James Cheston.

His education was in the hands of governesses until he was nearly twelve years old, when he was sent to the Academy of Samuel Crawford, on Fourth Street below Arch Street. In his "Reminiscences," published in the Alumni Register of the University of Pennsylvania, Dr. Morris says:

[1] Read May 7, 1924.

"This was the University Grammar School, owned by the University, and used for special events by University students." . . "The upper rooms of it were used as a church by the Covenanters on Sunday and on weekdays 'Sammy' would take such of us up there as needed special thrashings. He would thrash off four or five inches of his rattan every day until it got too short; then he would get a new one."

In 1844, he graduated from school and, a boy of thirteen years, entered the arts department of the University of Pennsylvania. During the sophomore year he was removed from college by his father and put to work in the iron store of Morris, Jones & Co., under the care of his uncle, Israel. Here he remained for about two years and a half, when he reëntered the arts department of the University and graduated in 1851. In 1854 he graduated with the degree of Doctor of Medicine from the medical department of the University of Pennsylvania. At that time the University buildings were on Ninth Street between Chestnut and Market Streets, where the General Post Office now stands. Of his student days he says:

"The principal sport was skating. There was not much time for this, but there were some skating teams. If you got two or three days' skating during the winter you were doing pretty well." (I think that he must refer to skating on the Schuylkill.) "Of course, in addition to that dignified diversion there were many sporadic amusements such as upsetting the police round-boxes on the street. Though never personally present at these particular events, I heard of them, and of the castor-oil bottle the police were said to keep inside their boxes, ready to administer to such boys as they arrested."[1]

A story of his medical student days, which he related with much

[1] For the benefit of the younger generations, to whom the sport of upsetting the round-boxes of the watchmen may be unknown, I would explain that these "round-boxes" were octagonal in shape (much like the shelters recently placed for the traffic officers), and were located in desirable localities for the sheltering of the city watchman. The game seems to have been to fasten the door shut by means of a rope thrown around the house and then tip the house over—of course, with the watchman inside—preferably the house was thrown over with the door on the under side, since that added to the difficulties of the watchman in freeing himself. It seems to have been a pastime much enjoyed by the "Young Bloods" of that day.

glee, was that at one time he had the body of a newborn infant for dissection. In order that the subject should not be stolen by a fellow-student, he was in the habit of taking it home with him at night, wrapped in newspaper. One morning, going down Chestnut Street, with his newspaper bundle under his arm, a gentleman tapped him on the shoulder and remarked, "Doctor, the foot is sticking out!" Sure enough, it was!

He began the practice of medicine in Chestnut Street above Eighteenth Street, shortly afterward moving to 1435 Spruce Street, and in 1872 again moving to 1514 Spruce Street, where he continued to reside until two or three years before his death. In addition to a large private practice, Dr. Morris was physician to the Foster Home for Children from 1856 to 1860; to the Moyamensing House of Industry from 1855 to 1859; and from 1855 to 1863 inclusive, he examined in connection with the lectures on Practice, Materia Medica, Chemistry and the Institutes of Medicine in the University of Pennsylvania; he also lectured there on Microscopic Anatomy. From 1857 to 1872 he was physician to the Episcopal Hospital, which his father, Dr. Caspar Morris, had been largely instrumental in founding. Dr. Cheston Morris gives following account of the turning of the first sod for the building of the hospital:

"When riding on the street car one day, I met Mr. John Welsh, with several other gentlemen, who were on their way to break ground for the present main building. Mr. Welsh notified me of their intention and invited me to join them. I thanked him, but thought nothing more of it for an hour or two while at work as usual in my wards, when suddenly a messenger informed me that Mr. Welsh and the gentlemen were all waiting for me. I hurried out to them, and Mr. Welsh said, rather crossly, I thought: 'Dr. Morris, we have come to break ground for this work, and have waited a long time for you, as representative of your father, to take out the first spadeful of earth; here is the spade.' I took it and prepared to dig. 'Hold on,' he cried out, 'You must make a speech first!' I stopped and said:

'In nomine Patris, et Filii, et Spiritus Sancti, hospitium instituo:
Ad majorem Dei gloriam salutemque generis humani.'

"To which Mr. Welsh promptly responded, 'Amen.' I then added to him: Mr. Welsh, as the representative of my father, whose letter to Bishop Potter started this work, I place this spade in the ground. To the support you have so nobly given is due the prospect of success we enjoy this day, and to you I leave the pleasure of removing the first spadeful of earth.' So the Hospital was begun."

In addition to his service at the Episcopal Hospital, he was a contract surgeon in the Union Army from October, 1862, to August, 1863.

About 1858 or 1859 he was associated with Dr. S. Weir Mitchell in the study of snake poisons. I can find no reference to this in Dr. Mitchell's writings, but the snakes were furnished by my father, at that time employed by the Cambria Iron Company at Johnstown, Pa. The snakes (rattlesnakes and copperheads) were kept in the cellar of the Academy of Natural Sciences, at that time at the northwest corner of Broad and Sansom Streets. One evening Dr. Mitchell and Dr. Morris went to experiment with their snakes; and going down the cellar stairs, candle in hand, they heard an ominous hiss on the step below them—their pets, about nine in all, had escaped from their box and a big copper-head was coiled on the step below them! They recaptured six and put them back in their box, but three were not found. The newspapers of a day or so later contained an account of a rattlesnake killed at Broad and Chestnut Streets, and there was much speculation as to how the snake came there. Dr. Mitchell said nothing; Dr. Morris said nothing; and my father, in Johnstown, kept very quiet.

He was interested in other matters than medical. He took an active part in the work of the Academy of Natural Sciences, particularly the microscopical section. He was vice-president of the Pennsylvania Horticultural Society, and was one of the curators of the American Philosophical Society from 1889 to 1898. He was a member of the Devon Cattle Club since 1884, and since 1898 he was president of that organization and took an active interest in the preservation of a pure breed of Devon cattle in

the United States. This interest in cattle led him to write a book on the milk supply of large cities, which was published in 1884; and he was one of the first, if not the very first, to ship milk to his patients and patrons direct from the farm in glass bottles, instead of the large tin cans which we recall as a picture of boyhood days. He also wrote (in 1886) of the water supply of Philadelphia, showing how necessary it is for Philadelphia to reach out farther than the near-by Delaware and Schuylkill for an adequate water supply for her citizens. His chief literary work, however, was his translation from the German of C. G. Lehman's *Manual of Chemical Physiology*. This was in 1856—two years after his graduation in medicine.

He was a deep student of the Bible, and was accustomed to say that one should read the Bible in its Greek, Latin and Hebrew versions, in order to fully understand the meaning. He himself translated several of the books of the Old Testament from the Septuagint. For a number of years he conducted a large Bible Class for men, in connection with the Episcopal Church of the Holy Trinity, and it was in his house (in Chestnut Street above Eighteenth Street) that the first meetings were held for the organization of the Church of the Holy Trinity.

Dr. Morris was married twice. In 1854 (immediately after obtaining his medical degree) he married Hannah Ann Tyson, daughter of Isaac Tyson, Jr., and Hannah Ann Wood Tyson of Baltimore. From this marriage there were born six children, of whom four survive. Hannah Tyson Morris died in 1867. In 1870 he married Mrs. Mary Ella Stuart, daughter of Lawrence Johnson, of Philadelphia, and widow of William D. Stuart. From this marriage there were born eight children, of whom all survive.

Dr. Morris's personality was striking. Tall, with jet black hair and beard and dark complexion, he was a handsome man. In later life his gray beard and graying hair gave him a venerable look, and when age had stooped his shoulders and whitened his hair and beard, he reminded me of the pictures of the Patriarchs of old. His figure was a familiar one in the streets, and, until recent years, he could be seen driving in the high carriage of the style of some

years ago, drawn by a pair of small horses; or else, seated in a phaeton which had been built especially low for his father, so that he would not have to climb into his high carriage when he had lumbago, to which he was subject. Dr. Morris always said that that phaeton would rival Oliver Wendell Holmes' "Wonderful 'One-Hoss Shay,'" and if I am not mistaken, Dr. Caspar Morris's little low phaeton has nearly (if not quite) outlived the Deacon's vehicle; though I doubt if there is much of the original carriage left, since renewal of parts has been necessary from time to time.

Temperate in all other respects, Dr. Morris was an inveterate smoker, and his pipe was his constant companion in his waking hours; and, as I have said, his was a familiar figure in his low phaeton, with his colored coachman beside him and an equally dark meerschaum in his mouth, and the incense of the Goddess Nicotiana, like a halo, surrounding him.

A kindly, gentle gentleman, he retired a few years ago to his farm, "Fernbank," near West Chester, and his last years were spent among his books and at the farm he loved. A slight deafness was the only impairment of his faculties. Even death dealt gently with him. On November 28, 1923, he retired in as good health as is usual at ninety-two years of age, and in the morning it was found that Eternal Light had come with the earthly dawn. He had no last illness. "God's finger touched him and he slept."

ANNUAL ADDRESS OF THE PRESIDENT[1]

By THOMAS R. NEILSON, M.D.

It is again my duty and privilege to present to you a review of a year's work of the College.

At our December meeting the reports submitted by the Secretary, the Treasurer, the Chairman of the several Standing Committees and the Clerks of the Sections told in detail of the various departments and activities of the College for the year ending November 30, 1923. These reports are all accessible to every Fellow of the College, and may be seen in the office of the Clerk.

The report of the Library Committee, which is, as usual, very extensive, and will be published in its entirety in the *Transactions*, is replete with interesting details. The use made of the Library by the Fellows and by visitors varied but little from the previous year. The number of books taken out was slightly in excess, but the number supplied on request for consultation in the Library was greater by 6757.

It is gratifying to recall that during the year it was announced that one of the Fellows, Dr. E. E. Montgomery, generously stated his intention to establish a Fund, to be known by his name, the income to be used for the purchase and binding of books and journals devoted to Obstetrics, Gynecology and Abdominal Surgery. One thousand dollars of the amount has already been paid to the Treasurer.

The Hall Committee has faithfully discharged its duty in seeing to the upkeep of the building and the adjacent garden. The expense necessarily incurred by the College for the purposes of this Committee is very considerable, the main items being the

[1] Read January 2, 1924.

salary of the Superintendent, wages, electric light and power, fuel, telephone and painting. An oil-burning plant has been installed under one of the heaters, the cost—$2100.00—being met from the Hall Renewal Fund. This is expected to effect some reduction in the cost of fuel for the year, being especially economical in the mild weather of the cool seasons, when its intermittent operation can be accomplished at far less cost than coal. Another saving will be made in the total elimination of the expense of removing ashes.

Of the total sum expended by the Committee for the maintenance of our property—$12,000.00—the electric light and power bill amounts to more than $1600.00, while for wages some $5500.00 are required.

These figures show that the Committee was fully justified in asking the College to approve, which it did, of a moderate increase in the allowance asked for the use of the meeting rooms in the building.

The report of the Committee on the Directory for Nurses shows again a successful year of operation. At the end of its year the Directory had on its roll 632 women nurses, 22 certificate nurses, 48 male nurses and 73 attendants—a total of 775. 172 nurses were registered, while 168 were removed from the register. 5657 calls were filled during the year.

The demand for short hours of duty, as well as for high pay, is being observed at the Directory, inasmuch as a considerable and growing number of nurses are unwilling to assume single-handed the care of patients requiring more or less continuous attendance. This is undoubtedly one of the outgrowths of the lengthened period required and the highly elaborate course of tuition in training-schools today. The trained, or registered nurse, has become a person whose services are really, for many people of average moderate circumstances, a costly luxury, to be had only on occasion of dire necessity, and that at heavy expense.

There is a growing opportunity for the "certificate nurse." Not only is the supply of full-course graduate nurses becoming unequal to the demand—apart from their insistence upon short hours of

duty—but for many cases, and in large number of homes, the less costly "certificate nurse" is amply qualified to meet ordinary requirements. It is much to be regretted that there are not more of this class of nurses. Their registration at our Directory should be encouraged.

The Committee of Publication succeeded in getting out quite promptly the *Transactions* for the preceding year, a volume altogether creditable to the College, and for the production of which the editor is entitled to an expression of appreciation of his painstaking labors.

The offices of the Committee on Entertainments were called upon on the occasion of a reception given on January 2, 1923, to Dr. Etienne Burnet, Special Delegate of the French Government to the celebration in Philadelphia and New York of the centenary of Louis Pasteur. Dr. Burnet, Director of the Pasteur Institute at Tunis, made a delightful and very interesting address before the reception, and the entertainment was altogether very successful.

Scientific Business. The scientific communications at the nine meetings of the College comprised four lectures and fourteen papers, the programs being arranged by the Committee on Scientific Business. Four of the meetings were devoted to the lectures —the ninth, tenth and eleventh under the Mary Scott Newbold Foundation, and the fifth of the Nathan Lewis Hatfield Lectures. At the December meeting Dr. Donald C. Balfour, of the Mayo Clinic, delivered a Mary Scott Newbold Lecture, choosing for his subject, "Hematemesis." The next one was given by Dr. J. J. R. Macleod, of the University of Toronto, on "Experimental Investigations on Diabetes." At the April meeting another was delivered by Prof. Leon Asher, of Berne, Switzerland, on "The Physiology of the Lymphatics."

The Hatfield Lecture was given at the June meeting by Dr. Frederick Grant Banting, under the title "The Use of Insulin in the Treatment of Diabetes Mellitus."

Fourteen papers, six of them read by invited guests, filled the programs of the remaining five meetings.

Your President feels impelled to comment, as he did a year ago, on the small number of papers contributed by Fellows at the meetings of the College. The eight papers presented by Fellows were all of a high order of merit, and were valuable contributions to our *Transactions*. But from such a membership as that of the College there should be many more such scientific communications worthy of presentation at our meetings. The College does not look to its older Fellows alone for the production of papers. It will expect to hear also from those more recently honored by election to Fellowship, of whom in the last six years there are as many as eighty-four.

The attendance of Fellows at the meetings, at least during the scientific business, showed a material improvement over that of last year, although still not what it should be; but at the private sessions the number of Fellows present is seldom more than sufficient. Your President would plead for a better attendance at our business sessions. The duty and privilege of sharing in the deliberations upon the business of the College, with its attendant responsibilities, is incumbent upon every Fellow. Especially should the younger Fellows, upon whom in time will rest the honor and the duty of seeing to the welfare of the institution, of preserving its sacred traditions and of upholding its dignity and fame, grow familiar with its affairs, and do their share in the despatch of its private business.

The reports of the Sections show them all to be active and doing good work. Of the three principal ones—that on General Medicine, that on Ophthalmology and that on Otology and Laryngology—the first named has naturally the largest membership, 128; the Section on Ophthalmology has 41 members, while that on Otology and Laryngology reports its number of members as 29. The attendance of Fellows and of invited guests at the meetings of these sections was good, and the number and the character of papers contributed were very creditable. The Section on Medical History had three very interesting meetings during the year; while that on Public Health and Industrial Medicine, with a gratifying increase in its membership, had two meetings. This

last-named section has undoubtedly a field of usefulness to fill, and its activity and efficiency will be stimulated and developed if papers or addresses coming within its scope be presented at its meetings rather than at sessions of the College itself.

The Council has performed its duties with the utmost fidelity. Its meetings have had a very full attendance, and every matter brought to its attention has received thorough and fair discussion and deliberate action. In the consideration of Propositions for Fellowship, 19 out of 22 of which received favorable recommendation during the year, the Council performs its highly responsible duty with the most honest effort to be fair and just.

As to Membership. On December 1, 1922, we had on our roll 486 Fellows, 20 Associate Fellows (of whom 13 were American and 7 foreign) and 6 Corresponding Members, a total of 512. During the year the College lost by death 7 Fellows, 1 foreign Associate Fellow and 1 Corresponding Member. One Fellow resigned.

Dr. George G. Ross, elected a Fellow in January, 1898, died on December 27, 1922, at the age of fifty-six years.

After graduation at the University of Pennsylvania he served as intern at the then German, but now for some years the Lankenau Hospital, to which institution he was, in 1899, appointed Assistant Surgeon under Dr. John B. Deaver. This position he continued to fill the rest of his life.

He was also surgeon to the Germantown Hospital for many years, to the Stetson Hospital from 1911 to 1918 and to the Methodist Hospital from 1919.

He was connected with the School of Medicine of the University of Pennsylvania as an Instructor in Surgery from 1911 to 1919, when he was appointed Associate in Surgery, and at the same time Assistant Surgeon to the University Hospital.

In the World War he served as a Commander in the Medical Corps of the United States Navy.

To the literature of surgery, Dr. Ross contributed a number of valuable papers and case reports.

He was an interested Fellow of the College, and was a member of the Council at the time of his death.

A diligent and conscientious worker, he enjoyed a well-earned reputation for his skill and judgment as a surgeon, and his attractive personality drew to him a host of friends.

Dr. William H. Morrison, elected to Fellowship on February 7, 1906, died in his sixty-seventh year, on December 31, 1922. He graduated in medicine in 1880 at the University of Pennsylvania.

Although often present at the meetings of the College, he did not become conspicuous in its affairs, nor did he contribute much to medical literature. He devoted himself to general practice, in which he was quite successful.

Dr. Guthrie McConnell, who was elected a Fellow on June 3, 1903, died at the age of forty-seven years, in Cleveland, Ohio, on January 5, 1923.

Graduating from the University of Pennsylvania in 1896, he served a term as Resident Physician at the Episcopal Hospital and soon became interested in pathology and bacteriology. In this department of medical science he did much work, and for some years held the chair of Pathology at the St. Louis University. Later, returning to Philadelphia, he was made Professor of Pathology, Bacteriology and Hygiene in the Temple University.

He served in the recent war in the Medical Corps of the United States Army.

Dr. James Darrach, a Fellow of this College for sixty-four years, elected in April, 1859, died on June 17, 1923, in his ninety-fifth year.

He was graduated of the Pennsylvania Medical College in 1852. From the University of Pennsylvania he earned the degree of Bachelor of Arts in 1849 and of Master of Arts in 1852. In 1853 and 1854 he was Resident Physician at the Pennsylvania Hospital.

When he began practice Dr. Darrach lived on Arch Street, then and for many years afterward one of the chosen localities for doctors, and a favorite street for the homes of many of the substantial people of the city.

During the Civil War he served in the Medical Corps of the Union Army, and was in charge of the Cuyler Hospital, in Germantown.

Later he took up his residence in Germantown, where as a leading physician he had for long years a very extensive practice. Both to the Germantown and to the Jewish Hospitals he was Consulting Physician.

When compelled by advanced age to lay down the burden of his exacting work, Dr. Darrach moved to Atlantic City, where his last years were spent.

Dr. Charles Lincoln Furbush, elected to Fellowship on November 2, 1910, died on June 26, 1923, at the age of sixty years. At the time of his death he was Director of the Department of Public Health in this city. He was a graduate of the Medico-Chirurgical College of Philadelphia.

Dr. Furbush's life work was along the lines of Public Health and Sanitation. So much had he done, and so marked was his ability in that field, that the Censors have recommended that the President appoint a Fellow to prepare a Memoir of him. For this reason I will not even outline his activities in Havana, under appointment by the Government, his work with the American Expeditionary Forces in France during the World War, nor that in 1912, under the Rockefeller Foundation, as a member of the Yellow Fever Commission to Central America.

Dr. Furbush was a most agreeable and companionable man. Enthusiastic in the discharge of his duties, he worked too hard, and died of arteriosclerosis, still apparently in the prime of life.

Dr. James Kelly Young, who was elected a Fellow on February 6, 1889, died on August 28, 1923, in his sixty-second year.

Graduating in 1883 at the University of Pennsylvania, he next

served a term as intern at the Philadelphia General Hospital, and then began his career as an orthopedic surgeon by receiving an appointment as Instructor in Orthopedic Surgery in the University and one as Assistant in the Orthopedic Dispensary of the University Hospital with the late Dr. A. Sydney Roberts, the department being then, as it was for years afterward, under the direction of its distinguished founder, the late Dr. DeForrest Willard.

Working diligently and showing unquestioned capability, Dr. Young was elected in turn Professor of Orthopedic Surgery in the Philadelphia Polyclinic, Clinical Professor of Orthopedic Surgery in the Woman's Medical College, Associate in Orthopedic Surgery in the University of Pennsylvania, and finally, in 1920, Professor of Orthopedics in the Graduate School of the University. For years he was Orthopedic Surgeon to the Philadelphia General Hospital and Assistant Orthopedic Surgeon to the University Hospital.

He was quite a prolific writer, many papers relating to Orthopedics coming from his pen, as well as *A Handbook of Anatomy, A Practical Treatise on Orthopedic Surgery* and *A Manual and Atlas of Orthopedic Surgery.*

Tireless and enthusiastic in his chosen work, he built up a large private practice, his pleasant manner and genuine interest in his patients contributing in no small degree to his success.

Dr. James Cheston Morris, who for a long time headed the list as the veteran Fellow of the College, died on November 29, 1923, in his ninety-third year. Elected in October, 1856, his Fellowship continued through a period of sixty-seven years. From the University of Pennsylvania he received his medical degree in 1854. For a number of years he was Attending Physician to the Episcopal Hospital.

A family practitioner of the old type, he had quite an extensive practice, and for years was a familiar figure as he rode about the streets on his rounds, usually smoking a large meerschaum pipe and seated in a quaint old doctor's carriage, drawn by a faithful little pair of horses, long accustomed to their duty—a truly

characteristic picture, which those of us who are old enough to have seen will never forget.

On recommendation of the Censors a Fellow will be appointed to prepare a Memoir of this notable man.

Sir Thomas George Roddick, of Montreal, a distinguished Associate Fellow, elected in 1898, died on March 20, 1923, at the age of seventy-six years.

A widely-known surgeon, he was, in turn, Professor—later Emeritus Professor—of Surgery, Dean of the Medical Faculty and finally a governor of McGill University. Because of his distinguished work, he was knighted in 1914.

Dr. Cyrus Lee Stevens, of Athens, Pa., a Corresponding Member, elected in 1917, died at the age of seventy-one years, on February 19, 1923.

Dr. Stevens was prominent in the affairs of the State Medical Society of Pennsylvania, of which he was at one time President, and was also editor of the *Pennsylvania Medical Journal,* and Consulting Surgeon to the Robert Packer Hospital at Sayre, Pa.

Nineteen new Fellows were added by election during the year.

On December 1, 1923, the roll of the College included:

497 Fellows; 19 Associate Fellows (13 American and 6 foreign;) 5 Corresponding Members. Total, 521.

Of the 497 Fellows, 451 reside in Philadelphia or in its immediate vicinity, while the remaining 46 are non-residents.

Of the Finances. The report of the Treasurer shows the finances of the College to be in an entirely satisfactory condition, the affairs of this department continuing to be administered with the utmost fidelity by that officer in association with the Committee on Finance.

The income available to meet the general operating expenses of the College is scarcely more than sufficient, and would not be so if the Committee were to recommend in full the appropriations

asked for by all the Standing Committees having expenditures to make. An increase in our endowment for the general purposes of the College is earnestly to be hoped for.

The College is fortunate in having the continued services of the Librarian and Superintendent, Mr. Charles Perry Fisher, and of of Miss Zelner, the Clerk and Bookkeeper. To both of them our thanks are due for their fidelity and efficiency in the discharge of their duties.

THE TREATMENT OF BICHLORIDE OF MERCURY POISONING[1]

By JOSEPH C. DOANE, M.D.

The justification for the presentation of this paper does not lie either in the speaker's ability to present startling statistics as to recovery in mercury poisoning or in any real or supposed innovations in treatment. We are, however, of the opinion that present-day clinicians are sometimes too strongly impressed with the prognostic hopelessness of these patients, and that this mental attitude does not reflect favorably on either the promptness, planning or persistence of treatment. We will touch in detail only on those types of treatment with which we have had experience, and merely mention, for the sake of completeness, the use of certain other therapeutic measures of more or less proven specific chemical action.

At the outset brief mention should be made of certain basic, and usually well-known, facts relative to the absorption and elimination of mercury from the body, since they have a very definite bearing on the successful prosecution of any type of treatment. Special attention is invited to two important considerations in this relation—that the gastric mucosa has been proven by Lieb, Goodwin, Wellander and others to be actively concerned in eliminating mercury, and that the mucous membranes of the colon and upper rectum is also very active in excreting this drug. Flexner and Sweet have demonstrated that mercury absorbed by the gastrointestinal tract is taken up by the liver, secreted by the bile and then reabsorbed by the intestines.

[1] Read January 2, 1924.

The renal tubular mucous membrane appears to possess a specific affinity for this poison, for here we see a necrosis which appears to be out of proportion to the damage done to other bodily tissues, which are brought in contact with blood containing mercury in no less concentration. The damage to the renal tubules is, therefore, probably not largely done by the mercury-laden urine, but is a part of a general tissue damage done by a blood stream, richly supplied with this poison. This fact appears to be of therapeutic importance, because even when no mercury is found in the urine, if the blood is from time to time receiving this drug from some tissue where it has been stored, the kidney damage is still taking place.

There are two great classes of cases of bichloride poisoning—those which actually swallowed the drug and those which did not. This statement appears to smack of triviality, until it is explained that without any intention of deceit not a few of the latter type creep into statistical studies as cured cases. We have recently observed a patient who came to the hospital, stating that she had swallowed a number of bichloride tablets. No mercury was discovered in the vomitus, urine or stools, although the patient was strenuously treated because of the fear of overlooking a therapeutic need. Before she left the hospital it was learned that the tablets—the nature of which was not certainly learned—were dissolved in milk before taking, and that the motive appeared to be to bring an erring colored spouse to leash, and thus discourage his attentions to other ladies of color in the vicinity. Waving our hand at such a patient would have filled the same need as did our diuresis and colonic irrigation. Let it be said, however, in passing that it is far wiser to actively treat ten such cases, which later are found not to be in need of such care, than to delay one hour waiting for confirmatory symptoms to develop.

The failure to detect mercury in the stomach and intestinal contents and the absence of the metal in the urine are the only certain criteria by which the need for treatment can be judged, and until the laboratory has furnished this data the case should be adjudged one of real mercury poisoning.

Prior to the last decade the treatment of acute mercurial poisoning had fallen into a state of hopelessness, which served to discourage any thorough scientific search for the means of saving even a meager proportion of these patients.

In 1913 Linhart suggested that sodium phosphite in conjunction with sodium acetate had the property of reducing mercuric chloride *in vitro* to the harmless calomel. Carter clinically developed this idea in 1914 and gave to this antidote his name, by which it has since been known.

These experiments stimulated others to endeavor to neutralize, or, at least, to render this poison innocuous, and, as a result of the work of Lambert and Patterson, Wilms, Rosenbloom, Fantus and Hyatt, Weiss and others, much has been learned about the pathology, symptomatology and treatment of poisoning by this drug.

There are several important considerations which apply to all types of treatment of acute mercurial poisoning.

1. Most patients who have absorbed the lethal dose of mercuric chloride will die in from four to seven days.

2. No treatment can promise as much as can one which depends largely on actual removal of the poison before absorption.

3. Some patients will die who are promptly treated by the most modern methods.

4. Not a few patients can be saved by the prompt adoption of newer principles of treatment.

5. The treatment now used by many physicians is casual, lacking in system, not vigorously pushed and usually productive of a much too high mortality.

Sansum states if 4 mg. of mercury per kilo of body weight has gained access into the extraportal circulation that there are no grounds for believing that any treatment will save life. If this be true no further argument is required to justify either the greatest speed in preventing absorption or the existence of an honest disbelief in some too brilliant results of treatment which appear in the medical literature.

The early administration of an albuminous substance is, of course, of prime importance, the stomach mucous membrane being

at once thoroughly cleansed, to remove the mercuric albuminate thus formed. A portion of the stomach contents should, of course, be saved for examination for mercury to establish the need for treatment.

Fantus has shown, as a result of careful and exhaustive animal experiments, that for this purpose egg albumen is much more efficient than is milk. Indeed, this observer states that although 1000 parts of milk will remove 1 part of mercury from solution, yet when mercury in this solution is thus fed to rabbits these animals lived no longer than if water had been used as a diluent. The only difference observed was an absence of local corrosive lesions when milk was used.

Fantus suggests, as a result of his experiments, the use of milk as a vehicle when mercury is to be given by mouth, since it minimized the local effect of mercury on the stomach without interfering with its systemic action. Due to the promptness with which Hg is absorbed, unless administered with the mercury or almost immediately thereafter, no exogenous albumin is able to break the bond of saturation which exists between the drug and the tissue albumins. The greatest good, therefore, comes from the lavage and not the albumin.

The emergency measures having been carried out, the physician must now determine the type of routine which is to be followed, for the next seven to twenty-one days, for this part of the treatment must of necessity be more or less prolonged. The physician has the following types of treatment from which to choose:

1. The alkaline eliminative treatment, suggested by Lambert and Patterson.

2. The calcium sulphide treatment.

3. The sodium phosphite treatment, advised by Linhart and Carter (Carter's antidote).

4. The sodium hypophosphite treatment, urged by Fantus and Rosenbloom.

5. A combination of the most promising features of the above, which may also include certain surgical procedures, such as renal decapsulation, cecostomy or appendicostomy.

The alkalinity eliminative treatment seems to be especially useful, for not only has it been as efficacious as any, but also because it requires no equipment in drugs or personnel, which the average clinician will not usually find at hand. It can also be used as a basic routine, to which may be added the administration of any or all of the special drugs mentioned above. This routine is as follows:

When vomiting has ceased an alkaline mixture is administered, which serves to combat acidosis, as well as dilute the poison in the blood stream, and thus, to some extent, spare the kidney. The well-known Imperial Drink is as useful as any. Eight ounces of this mixture should be given every two hours, alternating with 8 ounces of milk. A solution of potassium acetate—1 dram to the pint—should be given by bowel, by the drip method, continuously day and night.

Since mercury is actively eliminated by the colonic mucous membrane, the lower bowel should be copiously flushed twice daily, until the washings no longer return a positive test for mercury. For the same reason the stomach should be washed twice daily with a 5 per cent sodium bicarbonate solution or with warm water. A hot pack should be given daily. I have cautiously used, with good results, pilocarpin, $\frac{1}{8}$ gr., by hypodermic, at the beginning of the pack, to promote sweating. This drug is especially useful late in the treatment, when the sweat glands seem to be too fatigued to respond to the usual physical measures.

This treatment should be continued from one to three weeks, dependent on the chemical examination of the body fluids and the functioning of the kidneys.

The use of calcium sulphide was first suggested by Haywood and Allyn, in 1913, but was later clinically developed by Wilms and Holm. It is based on the fact that when mercuric chloride and calcium sulphide are brought together in a test-tube an inert substance — mercuric sulphide — is almost immediately formed: $CaS - HgCl_2 = CaCl_2 - HgS$.

In the test-tube 1 gr. of calcium sulphide will render 4 gr. of mercuric chloride inert, but it is customary for every grain of

mercuric chloride taken to administer, intravenously, 1 gr. of fresh calcium sulphide in 1 oz. of sterile water. Calcium sulphide is not very soluble in cold water, 1 gr. barely dissolving in 1 oz. of water. To obviate this difficulty the drug is added to sterile water, and then the solution is boiled, cooled and filtered through cotton and placed in a tightly stoppered bottle, ready for use.

Wilms cautions that the calcium sulphide should be fresh, since deteriorated preparations are toxic, due to the harmful action of the calcium radical on nerve tissue. Hydrogen sulphide is also found in old solutions.

Solutions of 1 gr. to 1 oz. of water may be used as a medium for lavage and 2 to 5 gr. every two hours may be given per gram until the odor of sulphuretted hydrogen is detected on the patient's breath.

Four patients, suffering as a result of poisoning with mercuric chloride have recently come under the speaker's observation. A very brief review of two of these cases may serve to illustrate the nature of the treatment given:

Case I.—E. K., female, aged thirty-four years, was seen by the speaker twelve hours after swallowing four mercuric chloride tablets, dissolved in 6 oz. of water. One hour after poisoning the whites of four eggs were given, followed by a very copious gastric lavage—several gallons of warm water were being used for this purpose. A saline purge was also administered.

Analysis of the gastric contents, obtained by lavage, showed large quantities of mercury. The urine contained albumin, hyaline and granular casts, a few red blood cells and many white cells. Her blood-pressure was 110/65. A laryngologist, who was requested to examine the larynx and pharynx, reported an acute inflammation of both, but no edema. There was no salivation or gingivitis observed at any time. The physical examination disclosed nothing unusual, except a bilateral apical tuberculosis (with which this patient was suffering), a remorseful mental state and a moderately distended and tender abdomen. The patient voided 8 oz. of urine during the first twenty-four hours. On the

second day the temperature was elevated to 103° and the urea nitrogen to 36 mg. per 100 c.c. The blood-pressure was 125/60. The disphagia had about disappeared. The patient voided 27 oz. of urine during the day. On the third day, or about eighty-five hours after poisoning, the patient stated that she felt better, had no complaints and asked for solid food. Her urinary output was 28½ oz., her blood urea 42 and her blood-pressure was now 132/72. This apparent well-being from the third to the seventh or eighth day is often but a medical mirage, which usually leads to false hopes of recovery and frequently causes a relinquishment in the strenuous prosecution of treatment.

On the fourth day the patient voided 33 oz. of urine; her blood-pressure was 130/66 and her blood urea 23.

On the fifth day 24 oz. of urine were excreted, and as yet no alarming symptoms had appeared, save a light somnolence, from which the patient could be easily aroused. Her plasma, CO_2, was now 77 per cent, her blood urea 22 and her phenolsulphonephthalein elimination 32 per cent. On the sixth day the urinary output had dropped to 18 oz., and her urea nitrogen was now 35 mg. per 100 c.c. Surgical consultation was sought as to the advisability of decapsulation of the kidneys. This was not deemed best at that time. The somnolence had deepened and the urine was heavily loaded with casts, albumin and red blood cells.

On the seventh day after poisoning but 6½ oz. of urine were excreted. The patient was somewhat stuporous, but could be easily aroused. On the eighth day 4 oz. of urine were voided, this being secured only after catheterization. The eye-ground examination was negative. The blood urea nitrogen was 73 and creatinin was 3.1. The stupor gradually deepened on the ninth and tenth days, there being 4¼ and 3 oz. of urine voided, respectively. There was a slight twitching of the facial muscles, the stupor deepened and dissolution took place on the morning of the eleventh day.

The alkaline eliminative treatment was used in this case, together with the administration of calcium sulphide. Due to difficulty in entering a vein, but 17 gr. of calcium sulphide could

be given in this manner, so that 3 gr. of this drug were administered per oram every third hour for three days.

Whether the delay in instituting both the emergency and routine measures was the deciding factor in determining the unfavorable outcome, or whether the pulmonary infection was preponderant, is debatable. Postmortem examination disclosed a caseation, with cavitation of a large portion of the upper lobes of both lungs; the kidneys were the seat of an acute inflammatory process, with box capsules, and a marked evidence of pseudo-membranous colitis.

Case II.—In the second case the outcome was more fortunate. This patient—an Italian woman, aged twenty-nine years—took $7\frac{1}{2}$ gr. of bichloride of mercury in mistake for aspirin. In ten minutes milk and the whites of eight eggs were administered by the husband, the patient vomiting soon after. On arrival at the hospital, one hour after poisoning, the stomach was washed with warm milk, and 7 gr. of calcium sulphide in 7 oz. of water was administered intravenously. A simple enema was at once given, followed by a copious colonic irrigation. Proctoclysis of potassium, acetate solution, 1 dram to the quart, was begun at once. The patient was given 8 oz. of Imperial Drink, alternating with a like quantity of milk, hourly. The stomach and colon were washed twice a day and the enteroclysis was continued without interruption. A hot pack was given once a day. The average daily intake per oram was 125 oz., and the urinary output varied from 50 to 75 ounces. The initial vomitus was heavily loaded with mercury. The feces returned a positive test for mercury on the second and third days, respectively, after poisoning, and the urine was positive three days after the mercury was taken, and was heavily loaded with casts and albumin.

This patient's recovery was uneventful, and she was discharged after a stay of thirteen days in the hospital.

Case III.—The patient's history was very similar to Case I, death taking place on the thirteenth day after poisoning. The

administration of calcium sulphide was delayed in this patient's case, however, three days.

Case IV.—The patient, alluded to, gave a very definite history of taking the poison, and was very energetically treated, but repeated chemical analyses of urine, feces and vomitus failed to reveal the presence of mercury, so that she cannot be considered as a true case of mercury toxicosis.

I have had no experience with the other types of treatment mentioned above, and therefore no personal opinion can be expressed, although Fantus, Rosenbloom and others recommend Carter's antidote, and in its absence the hypophosphite of soda combined with hydrogen peroxide.

Too much stress cannot be laid on the necessity of the early establishment of a routine which is religiously observed, day and night, until a clinical and chemical cure is obtained. The frequent cleansing of the stomach and colon is also of prime importance.

It would appear that the combination of a specific chemical, given intravenously, with the administration of large quantities of some alkaline diuretic solution, offers the best hope for recovery. Of course, if the neutralization of a toxic drug, which has gained entrance to the blood stream, was of test-tube simplicity, none need die of mercury poisoning, for I am convinced that if the calcium sulphide could be brought into intimate contact with the bichloride of mercury in the body tissues the result would always be a fortunate one. Wilms reports recoveries of patients who received the sulphide of calcium, by mouth, twelve hours, and by vein, thirty hours, after the ingestion of mercury.

Of the several surgical procedures, which have been suggested, but little can be said in their favor. This is no doubt partially explained by the fact that renal decapsulation is usually deferred until nothing but a miracle could save life.

I have long wanted to observe the result obtained by an early stripping of the kidney capsule before any evidence of nitrogenous retention was observed.

Anderson and Harrold have irrigated the colon through a cecostomy wound in bichloride poisoning. Transfusion of blood has yet to prove itself a useful measure.

It is probable, except under the most favorable circumstances, that whatever type of treatment in mercury poisoning is adopted, hospitalization is indicated, from the standpoint of access both to adequate laboratory facilities and to competent nursing service.

Finally, that treatment is best which does not, with unquestioning faith, trust favorable chemical reactions, but which, with zeal and intelligence, eliminates, neutralizes and above all else actually removes the poison from the system before absorption has taken place.

DISCUSSION

Dr. Henry K. Mohler: Dr. Doane has presented in a very practical and rational manner a subject which is of great importance. Methods of suicide vary in different decades. Statistics published by the city of New York show that from 1890 to 1900 Paris green was the chemical agent most frequently employed, from 1900 to 1910 carbolic acid held sway and since 1910 bichloride of mercury has probably been the most common chemical means of bringing about suicide. The use of illuminating gas for suicidal purposes has been more frequent than any of these chemicals.

One of the most interesting phases of the subject is a review of the statistics of a hospital in which a number of cases of bichloride of mercury poisoning have been treated. In the records of Jefferson Hospital, from 1912 to date, there are 56 *bona fide* cases, so diagnosed from the history, the recovery of bichloride of mercury from the vomitus, the stomach washings and from the urine. Three cases were doubtful because of lack of sufficient evidence.

It has been my opportunity to follow approximately 75 per cent of these cases: 40 patients recovered, 12 died and 4 signed releases, leaving the hospital before the results of poisoning could be ascertained. A mortality of 28 per cent resulted in this series of 56 cases. Of these 56 cases, 3 were bichloride of mercury poisoning by use of the drug in solution as a vaginal douche; 2 of the 3 patients died; 32 of the patients were between the ages of twenty and thirty years.

From these statistics it would seem that the age of suicide and the age of mistake is between twenty and thirty years; 28 of the patients took

the drug with suicidal intent and the remaining number by mistake. When taken by mistake, it was frequently for veronal or aspirin tablets. In 3 instances bichloride of mercury tablets were mistaken for candy by the patients while under the influence of alcohol. In our series these have been included as "poisoning by accident." Of the 56 cases, 23 were men and 33 were women. Three of the 28 cases who took the drug by accident succumbed. The largest amount of the bichloride of mercury taken, with recovery, was four tablets, approximately 30 gr. Immediately upon taking the tablets the patient came to the hospital. The greatest length of time that elapsed after taking the drug by mouth in any patient who recovered was two hours. This observation emphasizes the value of prompt treatment.

The plan of treatment consisted of the introduction of alkali by mouth, by rectum, gastric lavage with bicarbonate of soda, and by means of increased elimination. Calcium sulphide was employed in 3 cases in addition to this treatment. If calcium sulphide is of value, it would seem that it must be used by intravenous injection.

The bichloride tablets usually offered for sale are composed of equal amounts of chloride of ammonia, or chloride of soda, and bichloride of mercury, the former for the purpose of facilitating solution of the bichloride of mercury.

There are tablets on the market to which citric or tartaric acid has been added, which increases the solubility of the bichloride of mercury by preventing the formation of an albuminate. Dr. E. Q. Thornton has called my attention to the necessity of freely using sodium bicarbonate, in washing out the stomach, when poisoning is suspected by bichloride of mercury tablets in which citric or tartaric acid has been added.

Mercury is eliminated over a period of days by the gastric mucosa, and washing out the stomach once or twice is not sufficient. Daily gastric lavage should be used for at least one week. This procedure may be painful because of an esophagitis or pharyngitis.

Treatment before 1914 consisted in increasing elimination and by the use of alkalies by mouth, by gastric lavage and by enteroclysis. Lambert and Patterson, in 1914, developed the drink referred to by Dr. Doane as "Imperial Drink," and now very generally used.

The factors which influence the prognosis and the results obtained from the treatment depend upon the earliness with which these measures are instituted and the effectiveness with which the treatment is pursued. Dr. Doane has mentioned, and I would emphasize, the importance of systematically treating all patients suspected of having taken bichloride of mercury until proven otherwise. Do not wait for laboratory reports before beginning treatment. More can be accomplished during the first two or three hours than in the next five or six days. In this series there

are patients who came to the hospital immediately after taking the bichloride and, in spite of prompt treatment, died. The majority of patients who came to the hospital within an hour or two after taking the poison recovered.

The condition of the kidneys previous to the ingestion of the poison is an important factor in the ultimate result.

Finally, when the organs are damaged to the degree shown in the specimens submitted by Dr. Lee no form of treatment can be expected to be effective.

Dr. Walter G. Elmer: I recall a case of fatal bichloride of mercury poisoning which occurred on the coast of Maine a number of years ago. The blood examinations were made almost daily by the late Dr. Nathaniel Gildersleeve, a Fellow of this College, who gave me the details at the time. It is interesting because the bichloride of mercury solution that was used was only 1 to 10,000. A single vaginal douche was given to the patient by her nurse, and yet sufficient of the poison was absorbed through the vaginal mucous membrane to cause a blood destruction. The red cells and the hemoglobin continued to fall progressively from day to day until the red cells were under 1,000,000 per cu. mm. and the hemoglobin below 17 per cent; the patient died on about the tenth day.

Dr Doane (closing): As the two gentlemen who have been so kind to me in their discussion have both said, the patient with bichloride poisoning lives or dies in the first two or three hours following poisoning.

The use of specific drugs in treating bichloride of mercury poisoning has always appeared to me as similar to certain specific treatments in cerebrospinal lues after certain spinal sclerosis has taken place. When damage has been done to kidney tubules, it appears that, no matter if you are able to reach the bichloride intimately and actively with a neutralizing drug, the existing pathology makes a slow, tedious repair the only possibility.

The two interesting specimens which Dr. Lee has presented show the extent of sloughing and necrosis which takes place in the colon. Not infrequently the colonic mucous membrane exfoliates in strips or casts, many inches long, after bichloride poisoning. It is obvious that calcium sulphide, or any other specific drug for that matter, could not repair this damage once it has taken place.

The probability is that in cases that recover less than 4 mg. of mercury per kilo of body weight has actually entered the extraportal circulation. When more than the lethal dose has gained entrance to the systemic circulation and extensive tissue destruction has taken place, it would appear almost a miracle to follow with any neutralizing drug and expect an inert substance to be formed and recovery to take place.

JUVENILE TABES DORSALIS, WITH DESTRUCTION OF HIPS FROM CHARCOT'S DISEASE[1]

By WALTER G. ELMER, M.D.

This patient is now eighteen years of age. When she was fourteen, while doing gymnastic exercises, she dislocated—or thought she had dislocated—her right hip. Later on she was able to walk and run, her hip remaining out of place. She had pain which extended down her limb to the foot. She walked with a limp, because of the shortening. She received chiropractic treatment. Later she was operated on by a prominent orthopedic surgeon, who removed the débris of the hip-joint, which had been destroyed. This was followed by drainage for twenty-two weeks. She wore a brace and a high shoe on the affected side, to make up for the shortening. Injections of neosalvarsan were begun at this time. She has been treated in several hospitals since then and at a sanitarium at the seashore.

I first examined her in May, 1921. Her right lower limb was $2\frac{3}{4}$ inches shorter than the left. The thigh could be flexed above a right angle, and in all other directions the range of movement was normal. The upper extremity of the femur was dislocated upward and moved freely about on the innominate bone. There were about 2 inches of free play upward and downward. Swelling and fluctuation indicated the presence of a large amount of fluid about the hip. The knee reflexes were absent. The pupils did not react to light. The *x*-ray picture showed complete destruction of the head and neck of the femur with an upward dislocation of the shaft. The acetabulum had almost

[1] Read January 2, 1924.

melted away. Up to this time she had received over fifty injections of neosalvarsan. The temperature range was from 98° to 102° and the pulse from 88 to 130. Weekly injections of neosalvarsan were given.

Two and a half months later the patient had improved in every way. She had a good color, had gained in weight and the fluid about the hip had been absorbed. She was provided with a brace with a padded ring, so that her weight was borne by the tuberosity of the ischium and none by the hip.

She could walk without crutches. The temperature by this time remained about normal, although the pulse-rate was rather rapid.

The patient returned to her home August 9, 1921. She was again admitted for hospital treatment in November, 1922. Her general condition was very satisfactory. She was in good health, temperature and pulse normal, no fluid about the hip and very little free play upward and downward of the femur upon the ilium. It required a three-inch block, under the right foot, to square the pelvis and straighten the spine. Injections of neosalvarsan were given.

Up to this time *x*-ray pictures of the left hip had revealed nothing abnormal.

On the day that she was to leave the hospital she slipped while standing beside her bed, but managed to fall over upon the bed instead of falling to the floor. She told me about this, fearing she might have injured her left hip. I examined her left hip as she lay supine upon the bed. The range of movement was free and normal in all directions—no crepitus, no pain—and I assured her the hip was uninjured. She left the hospital that afternoon.

On reaching home she climbed three flights of stairs and suddenly felt her left hip give way. I saw her at her home three days later, December 2, 1922. She had pain in her left hip and could not bear her weight upon it. There were marked tenderness and swelling about the hip and bone crepitus on motion. A diagnosis of fracture of the neck of the femur was made.

She was readmitted to the hospital. Temperature, 102°.

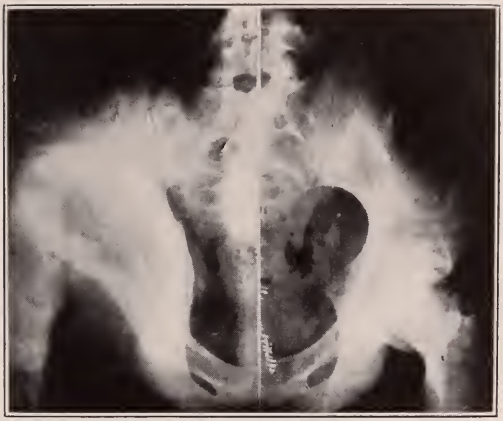

FIG. 1.—Showing complete destruction of the right hip: left hip is normal.

FIG. 2.—Showing the left hip still normal in June, 1921.

Buck's extension applied. Aspirated fluid was sterile. *X*-ray pictures confirmed the diagnosis, that is, pathological intracapsular fracture of the neck of the femur, due to the onset of Charcot's disease. The hip was immobilized in plaster of Paris from the toes to the thorax, another course of neosalvarsan was given, the temperature and pulse became normal and the fluid about the hip was absorbed.

January 22, 1923, the plaster cast was removed and braces put on. The patient then began to walk with crutches, no weight falling upon the hips but entirely upon the tuber ischii. She went to the seaside April 2, 1923.

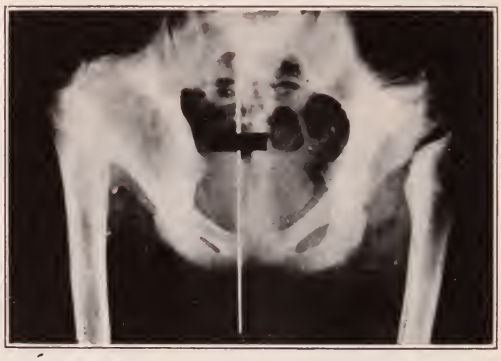

FIG. 3.—Showing that the left hip is following exactly the same course as the right.

October 22, 1923, she was again admitted to the hospital for examination. The *x*-ray picture showed the upward dislocation of the shaft of the left femur and a considerable portion of the head of the femur still remaining. The destruction of the acetabulum was following much the same course as in the right hip.

The patient had discarded her braces of her own accord in July and was walking with crutches. I had intended to protect her hips from weight-bearing for a long time—that is, long enough to permit dense fibrous connective tissue to firmly imbed the upper extremity of each femur upon the innominate bone, thus providing her with useful hip-joints. Temperature and pulse were normal;

she had gained in weight; her general health was excellent; no evidence of fluid about either hip; she was learning to walk a little—rather unsteadily—without her crutches; she had no pain.

The absence of the patellar reflexes, the Argyll-Robertson pupil and Romberg's symptom were clear indications that the earlier diagnosis of tabes dorsalis should remain unchanged.

The patient's attitude as she stands or walks is almost identical with that of double congenital dislocation of the hip. There is the marked lordosis and the prominence of each femoral extremity as it lies upon the dorsum of the ilium.

This girl is mentally normal, her intelligence, if anything, is rather above the average. She has a cheerful and happy disposition and has always been a favorite among the other patients in the hospital ward.

A series of Wassermann examinations was carried out from the time the patient first came under our care to the present time, and the only items of importance are as follows:

On November 16, 1922, the blood Wassermann was negative, the spinal fluid strongly positive, globulin negative, cells 3 per c.mm. On October 19, 1923, blood Wassermann was negative; spinal fluid negative.

Locomotor ataxia is a very unusual disease in children. It is so unusual that the text-books of pediatrics that I have examined do not even mention it. We have not been able to find any recorded case similar to the one here presented.

DISCUSSION

Dr. De Forest P. Willard: Dr. Elmer has reported a case tonight that, so far as I know, is unique. Juvenile tabes in itself is an extremely rare condition. In our clinic of the Graduate School, so far as I am aware, there has been but one other case of juvenile tabes reported in our records. Juvenile tabes with Charcot joints, such as he describes, is a condition that, as far as I can find either in hospital records or in my own, is an unknown condition, and when Dr. Elmer first mentioned this case

to me a few months ago, discussion came up as to the possibility of seeing cases of this sort. I made it a point to go through the abstracts of the literature, as far as I could find them in American literature, and to a certain extent in foreign literature. I have been unable to find any case such as Dr. Elmer has presented tonight. The treatment of the case is, I think, normal, and the outcome of the case as I would expect in a case of tabes. The great interest of the case lies entirely in the fact that it is unique, and for that reason should be reported in the literature.

Dr. George Wilson: Juvenile tabes is a rare disease in itself, and when one considers that ordinary tabes is complicated by Charcot joints in from 5 to 10 per cent of cases, it may readily be appreciated that a Charcot joint in juvenile tabes is extremely uncommon. I would question Dr. Elmer as to whether he has had an *x*-ray made of the spine in this case; the involvement of the spine in tabes is frequently overlooked.

Dr. Charles W. Burr: The last thing Dr. Wilson said makes me say this: I doubt very much if Charcot joints in adult locomotor ataxia is as rare as we think, because the more frequently we look for it the more often we find it. This very question of the spine, a gentleman whose name I cannot recall, a European, for some years back, has had as a part of his routine examination of all cases of locomotor ataxia an *x*-ray of the spine and of all the joints of the extremities. His percentage of Charcot joints is much larger because the *x*-ray reveals changes in the spine not ordinarily found, so that I think, really, the incidence is greater than we think. Furthermore, I think one reason of the rarity of juvenile locomotor ataxia is because until quite recent years we did not look for it at all. I have never seen a case, although I have looked for it, and I think we will find, just as when acromegaly was discovered, it was found not to be so uncommon when looked for, that when we look for joint disease and the more carefully children are examined, the more frequently these changes will be found. I have seen 10 cases of juvenile paresis in American children under fourteen years of age; all 10 of these were carefully examined, not with *x*-ray, but a careful clinical examination, and in not one of them that I can remember was there any focal joint, although several of them presented the clinical picture of locomotor ataxia. Some of them had only the picture of a general cerebrospinal syphilis. But Dr. Elmer's case is certainly interesting, and I think it behooves us all to examine children with still more care.

Dr. Francis X. Dercum: When Dr. Elmer described this case so beautifully, I recognized it as a patient who was under my care several years ago. Am I correct, Dr. Elmer?

Dr. Elmer: In 1920, Doctor.

Dr. Dercum: Three or four years ago. The diagnosis was made then of juvenile tabes, and disease of a hip-joint was discovered. The patient was *x*-rayed and was treated by intravenous injections and also spinal drainage—a favorite method with us at Jefferson. She greatly improved, so much so that we handed her over to the orthopedic department, and then she disappeared from our view. It is the first time that the case has been recalled to my mind. One fact that impressed me as remarkable was, that the joint improved apparently as the result of the arsphenamine injections and spinal drainage. If it were a trophic affection, should the joint improve as a result of medication? That is a question I think worth while considerating and discussing. It is a remarkable fact, but we do not under iodides or mercurials usually see such improvement. I cannot recall any adult case which improved either under iodide and mercurials or arsphenamine. Cases of juvenile tabes are very rare. I have seen but 4 or 5 in my many years of service at Jefferson and other hospitals. On the other hand, I have seen quite a number of cases of juvenile paresis. The case presented by Dr. Elmer strikes me as unique, and especially interesting because of the improvement in the joint.

Dr. Elmer (closing): In regard to the spine, I suppose we should have had a complete *x*-ray picture taken of the spinal column, as all we could see of the spine was the lower portion of the lumbar spine. I examined the patient repeatedly for any evidence of disease of the spinal column. She had a total right scoliosis in the early stage of rotation. The child could carry out gymnastic movements, showing a perfectly healthy, normal spine so far as I could determine clinically.

We believe both of the joints have been destroyed by the trophic changes. We do not think the destruction was primarily due to syphilitic infection. Of course, we did not expect the left hip to be destroyed. You can see how thoroughly she has been treated since the onset of her illness. She had 50 injections of neoarsphenamine before she came to us, and she has had 70 since. She is now learning to swim and to walk without the aid of crutches.

EARLY GALL-BLADDER PATHOLOGY[1]

By JOHN B. DEAVER, M.D.

The cause of disease is without doubt one of the most fundamental and perplexing problems which confronts the medical profession as a whole. In addition to this the surgeon faces another very important and perplexing problem, that is the early recognition of diseases which are surgical in their later course and thus essentially surgical from the very beginning. It was therefore, with considerable dismay, that I beheld the title assigned to me for this evening's discussion. The perplexities are rendered greater by the fact that it is not the early case which, as a rule, comes to the surgeon; thus he does not often have the opportunity of studying disorders in their earliest stages. The majority of surgeons, I feel sure, could tell much more about the later than about the early manifestations of surgical diseases. This, I believe, is true especially of gall-bladder cases, for in these, perhaps more than in any other type of surgical disease of the upper abdomen, with the possible exception of duodenal ulcer, the actual beginning dates back at least several years before the surgeon is consulted. Indeed, in the vast majority of instances cholecystitis, as we see it at the operating-table, is a cholecystitis of long standing, the first symptoms of which are generally referable to the stomach. I believe it is Moynihan who applies the term "gall-bladder dyspepsia" to these patients. Their diagnosis is usually confused under such terms as indigestion, gastric catarrh, neuralgia of the stomach or some other convenient but non-informative term. It is only rarely that patients in the early days of their trouble present

[1] Read February 6, 1924.

the characteristic picture of disease of the gall-bladder. By this I mean that they seldom complain of the symptoms as outlined in the various text-books. Their usual complaints are epigastric distress, more of the nature of vague discomfort than anything else, after meals, belching of gas, regurgitation, usually acid, and very little tenderness in the region of the gall-bladder. Perhaps there may be tenderness along the entire lower right costal margin. The *x*-ray, without which may of our modern clinicians would not dare to begin to make a diagnosis, practically never shows any abnormality in the region of the gall-bladder. Such is the vague history of patients in the early stages of their gall-bladder infection, and it is most difficult to recognize these symptoms as arising in that viscus. Ordinarily, the condition yields to intelligent medical treatment for a time, but our experience, as well as that of many others who have seen numerous cases, shows that sooner or later they come to the surgeon, and at operation the gall-bladder is found to be the site of an infective process which, from the pathologic anatomy of the organ, can be said to have been present for some time.

It is in the cases not perfectly clear clinically, and where immediate operation cannot be conscientiously advised, that the Lyon method of diagnosis and treatment should be given a trial. I frequently recommend it when consulted about operation and where I cannot satisfy myself of the wisdom of surgery at that particular time. It is not necessary for me to say that Dr. Lyon has given much thought and care to the development of his method and is carrying it out in a scientific, painstaking and conscientious manner.

The actual pathology of this early infection has been well described by MacCarthy, who, adopting the dynamic rather than the static viewpoint, characterizes it as not consisting of definite, clearly defined and easily distinguished pathologic lesions, but as stages of a pathologic process comprising an infection of the mucosa of the gall-bladder, and of the common or of the cystic ducts. This dynamic viewpoint, urged from the pathologic side, I am gratified to say, lends force to the surgeon's clinical arguments, that

the pathologic process is a progressive one. This, as has been so frequently pointed out, is one of the principal factors that render cholecystic disease so important and makes its early recognition so very desirable. The first changes in this progressive picture affect the mucosa, increased mucus is secreted and certain of the cells slough off. Beneath the mucosa there are the changes characteristic of inflammation, modified only by the fact that it is in a hollow organ, consisting of active congestion, and the formation of an exudate which in the milder cases may be merely of a serous nature with a few scattered pus cells entering the picture, and in the more pronounced ones is a violent suppurative inflammation of the worst type of infection. Personally I doubt, both from clinical and pathologic experience, whether the inflammation remains in the mucosa alone for more than a short period, because at operation the experienced eye can note changes in the luster of the organ and the experienced finger can detect certain definite changes in the thickness and elasticity of the walls of the viscus. Pathologically, the microscope reveals quite clearly the involvement of the walls of the inflammatory process. This in its turn leads to the more ready absorption of septic products and anatomically to the formation of the cholecystic adhesions which are so often encountered. I furthermore believe, on the basis of clinical experience, that a gall-bladder once infected rarely returns to an entirely normal condition. This is particularly true in cases where the chronic inflammation has been aggravated by the presence of stones. The resultant lesions can be corrected only by mechanical means. No one better than the surgeon is in the position to observe that complete restoration of anatomic conditions is rare indeed, and that the repeated attempts at healing only add to the deformity already established. This is readily explained by the close relationship between the gall-bladder and contiguous organs, and even though the infection in the gall-bladder may be self-limited, it is continuously subjected to the action of new infective bacteria coming from the liver.

Infection, as a causative factor of gall-bladder pathology, is no longer doubted, although the route by which this infection reaches

the organ is still a matter of discussion. More recently evidence is accumulating to indicate that the liver is the original distributor of the infection and the lymphatics are the avenue by which it is carried to the gall-bladder.

If this is true, then early gall-bladder pathology is really pathology of the liver and of the lymphatics leading to the gall-bladder. Many, or at least some, of the attacks of so-called biliousness are therefore expressions of early liver contamination by way of the portal system, the spleen and so on. In our work at ithe Lankenau Hospital we have for many years been finding hepatti,s and cholecystitis in liver tissue removed during cholecystectomy-that is, when the gall-bladder is removed bits of liver tissue adhere to it, and these have been carefully sectioned and studied. The pathologic lesion found practically constantly is degenera tion of the liver cells, which varies from a mild, cloudy swelling to decided fatty degeneration and even focal necrosis. The degenerative changes occur in the milder cases; in more serious cholecystitis we find practically constantly an increase in the connective tissue of the portal spaces, with frequent pus-cell infiltration, edema and other kinds of inflammatory exudate. Furthermore, the cross-sections of the small ducts which we encounter in these sections ofttimes show evidence of catarrh, or the more serious lesions of desquamation and the presence of a pus cell or two in their lumenæ. In brief, the liver tissue of the gall-bladder bed is never without involvement when the gall-bladder is diseased. May not then the pathology of the gall-bladder have its starting-point in the liver in certain cases, and if so, is not the symptomatology of early gall-bladder pathology practically the symptomatology of a low-grade hepatitis or cholangitis-cystitis? A very common picture in gall-bladder disease is an opaque area of the liver immediately overlying the gall-bladder. Furthermore, in the advanced cases the liver is frequently found fibrosed, particularly the right lobe. I must emphasize the right lobe, because pathology has taught us that the ordinary Laennec cirrhosis usually begins in the left lobe. Now it is important, in this consideration, to consider some of the pos-

sible reasons for these facts. Among French writers it has long been held that the various lobes of the liver have different functions, although no definite proof has been forthcoming that this is so. In some experimental work which we have done, we have found by catheterizing the ducts coming from separate lobes of the liver in the dog that, in fact, the rate and quality of secretion of bile varies in the different lobes. Our analyses have covered only bile pigment, bile salts, cholesterin and total nitrogen, and the quantities of these various substances has varied in twenty-four-hour samples from the different lobes of the liver in this animal. This work is far from complete—in fact, it is but in its beginning, but it is a suggestive one. In the dog the splenic vein enters or joins with the superior mesenteric at almost a right angle to form the portal vein. If India ink is injected into one of the radicles of the splenic vein, there is more of this substance deposited in the left lobe than in the right. If the India ink is injected into one of the intestinal vessels in the region of the ileocecal junction more of the India ink is carried to the right lobes than to the left—in other words, the segment of portal vein between its formation and the point where it divides into two main right and left branches is so short that there is not time for a complete mixing of the bloods coming from the splenic vein and the superior mesenteric vein. Furthermore, it has been shown by others that oil droplets and other substances injected in the same way are distributed in the same manner. This opens up a very interesting field for experiment. At present we can merely speculate, but does it not seem reasonable that toxic materials and bacteria should more likely be distributed to the right lobe, that is, closer to the region of the bed of the gall-bladder than to the left lobe? Is not the ileocecal region the most heavily infected part of the gastrointestinal tract, the cesspool, as it has been called? This does not even mention the appendix in that neighborhood, and you all know my feelings on the subject of appendicitis and its relation to upper abdominal disease.

Before going further, let me sum up what these factors mean. It seems to me that it will be necessary to think of early cholecystic

disease not only in terms of the gall-bladder, but also in terms of the liver; it seems that we should make efforts to detect these early changes in liver function. The small amount of experience we have had with so-called liver function tests have not been satisfying, but we feel that it is nothing to excite wonder. In the case of the kidney, we have an organ the secretion of which can readily be collected; furthermore, the function of the kidney, complicated as it is, we must admit is simple compared to the function of the liver, and it will be necessary to study the fundamentals of liver function and its subdivisions before any great amount of progress in this direction can be expected.

This matter of lymphatic passage of infection is quite intriguing. Our general knowledge of the methods of spread of infection via these channels is on a fairly secure foundation; but when we begin to ask specific questions in the case of specific organs, such as the gall-bladder, we are immediately confronted by many perplexities. It has been said that infection of the gall-bladder may travel upward from the duodenum through the lymphatics in the walls of the common duct and cystic duct. Obviously, if this is the case, infection may travel also in the opposite direction; and of this I am far more positive than of the former, for you all know my views on lymphangitis and lymphadenitis involving the glands along the cystic and common ducts and of pancreatic lymphadenitis and chronic pancreatitis. At least 25 per cent of my cases that come to operation for cholecystitis or cholelithiasis present some enlargement of the pancreatic lymph glands and the glands along the common duct. A more potent route possibly is that via the lymphatics from the liver in the neighborhood of the gall-bladder, which Adami referred to many years ago as subinfection, and which now is familiarly known as focal infection, etc. We know, too, that in certain circumstances it is possible for bacteria to penetrate the bowel wall, leaving it to all intents and purposes intact, and to enter the liver via the portal system, and that the liver may filter them out and excrete them in the bile and thus infect the gall-bladder, or they may enter the lymphatics and be carried to the gall-bladder via those channels. We

must not forget, however, that another possibility has been shown both in humans and in animals.[1] Charcoal, that is carbon particles, has been fed by mouth to patients with a biliary fistula; in less than twenty-four hours carbon particles have appeared in the fluid exuding from the fistula. Experimentally, it has been shown that this transport of carbon particles from the duodenum upward takes place along the mucous membrane of the common duct and has nothing to do with either peristalsis or antiperistalsis of the ducts. In other words, particulate matter can ascend the common duct from the duodenum. Be this as it may, the important point is that infection reaches the gall-bladder and tends to remain there once it has gained even a slight foothold, and that its early recognition and removal will prevent disastrous consequences, such as acute or chronic pancreatitis and possibly perforation of the gall-bladder, carcinoma, etc.

A notable contribution to the study of the gall-bladder is that made by Sweet, a few weeks ago, to the College, in which he called attention and emphasized anew the probable relationship between that troublesome condition known as visceroptosis or splanchnoptosis and cholecystic diseases. Visceroptosis accentuates the angulation of the gall-bladder on the cystic duct, thus preventing its proper emptying as well as its proper filling. It is not an uncommon complaint of patients presenting the clinical symptoms (confirmed by *x*-ray) of visceroptosis to have more or less vague pain in the right hypochondrium radiating to the back and right shoulder-blade, so characteristic of gall-bladder pathology. Since some of us at any rate, no longer operate for the relief of splanchnoptosis, we lose the opportunity of inspecting the gall-bladder. The diagnosis of cholecystic disease in these patients can be made ordinarily on clinical symptoms alone, and perhaps in certain instances by the collaboration of laboratory findings.

Then, again, appendicitis may be the forerunner of cholecystitis. I refer not so much to those cases in which the appendix lies high and by direct or almost direct continuity is in very close proximity to the gall-bladder, but those in which there have been several

Goldman: München. med. Wchnschr., 1912, p. 12.

repeated acute attacks of appendicitis, with comparative freedom in the interval between attacks; and of those cases in which there has been a progressive chronic inflammation. Clinically, I have frequently had occasion to observe, and no doubt many of you here have been confronted by the same circumstances, the strong resemblance between lesions in the gall-bladder and the symptoms of what later proved to be a chronic appendicitis; and, on the other hand, I have had the experience of finding that appendectomy fails to relieve a patient of his digestive troubles when on reopening the abdomen the actual site of disease is found to be lodged in the gall-bladder. This error in diagnosis is entirely pardonable because, as I have stated above, the differentiation between inflammation in an appendix, particularly when it is in a high position, and cholecystitis cannot always be made clinically, and in addition even with a good exposure in an opened abdomen the presence of cholecystitis may be doubtful. Cholecystic adhesions do not always indicate a diseased gall-bladder, but they certainly arouse the suspicion, and upon further evidence warrant the removal of that organ.

Next to disease of the gall-bladder the most common upper abdominal disorder is duodenal ulcer, which in my experience rarely gives rise to adhesions. Therefore, the presence of cholecystic adhesions may be taken to indicate not duodenal ulcer but cholecystitis, or possibly appendicitis. Adhesions as trouble-makers are familiar to us all. The diagnosis is often a convenient one to mask our lack of definite knowledge, but they are annoying to the victim and not less so to the surgeon who is called upon to remove them. The simple fact that inflammation of the gall-bladder and its vicinity is a potent cause of the development of adhesions is only another argument in support of the statement that deformity occasioned by cholecystitis rarely can be entirely corrected, and emphasizes all the more the desirability of early recognition and early treatment of disease of the gall-bladder. It is only by seeing a large number of cases in their early stage that the surgeon in coöperation with the internist and the pathologist will be able to make a more definite contribution to the subject than is represented by this attempt.

IMPROVEMENT IN THE ROENTGEN-RAY DIAGNOSIS OF GALL-BLADDER DISEASE[1]

By WILLIS F. MANGES, M.D.

The title of the paper indicates that we no longer confine ourselves to the proposition of demonstrating the presence of gall stones to establish a diagnosis of gall-bladder disease.

When gall-stone shadows are present the diagnosis is naturally positive. Many of the gall-bladders containing stones also give definite shadows of the outline of the gall-bladder and its other contents, and also frequently a pathologic gall-bladder that does not contain stones casts a distinguishable and positive shadow. In this case we feel that a diagnosis of gall-bladder disease is quite as positive as if gall-stone shadows had been present. This type of gall-bladder is not always shown in definite shadow, for its outline may be irregular because of adhesions, or it may be so far from its so-called normal position that we hesitate to distinguish it from some intestinal loop. If adhesions are present there is usually deformity of the stomach, duodenum or colon, and this gives us a fairly definite clue to the probability of pericholecystitis. Again, the gall-bladder that does not drain well if it comes in pressure contact with the stomach or duodenum, or even the hepatic flexure of the colon, will produce a depression that takes the shape of that part of the gall-bladder that is in contact. This is considered positive evidence of gall-bladder disease, because the peristaltic movements of the stomach or intestines should compress the gall-bladder—in fact, this is probably the most important factor in the physiology of the situation. This deformity may be present with the patient in one position and not in another.

[1] Read February 6, 1924.

So far we have enumerated the more common direct signs of diseased gall-bladder. There are certain functional disturbances and palpatory signs that frequently lend support to the diagnosis. hyperperistalsis of the stomach—especially of the multiple-wave type—is considered by Carman to be a rather important corroborative sign. More or less constant spasm of the antral end of the stomach may be present, but must be carefully differentiated from organic lesion of the stomach itself. We have found that hypermotility of the intestines, during the first six hours after the barium meal is given, is also very commonly associated with gall-bladder disease. Irritability of the duodenum and reversed peristalsis of the duodenum is another functional disturbance that is frequently noted. Undulating irregularity in the outline of the right diaphragm, according to Hickey, rather strongly indicates right upper quadrant pathology, although it is also present in appendix lesions, and it is sometimes difficult to rule out adhesions or irregularities on the upper surface of the liver. On palpation, in the presence of duodenal deformity, one may elicit tenderness or determine that adhesions exist. This, however, is only practicable in reasonably slender individuals.

When none of the positive signs are present, we naturally take the history and clinical aspects of the case into consideration and weigh these together with the indirect signs above enumerated, and if we succeed in eliminating organic lesion of the stomach, duodenum or appendix as the cause, we feel justified in making a probable diagnosis of gall-bladder disease. This, of course, may be spoken of as a diagnosis by exclusion.

Another and most important advantage in a roentgen-ray examination is that multiple lesions may be present or that lesions in the abdomen other than diseased gall-bladder may be present and be clearly demonstrated by means of the roentgen-ray. For instance, we have on numerous occasions found gall stones present when the patient's symptoms were definitely referable to the right kidney, or, as you will see in the slides, we have found gall stones and kidney stones in the same patient. And it is not an uncommon occurrence to find a patient who has a duodenal ulcer, a gall-

bladder lesion and a diseased appendix or some other organic lesion in the abdomen. In view of these facts, we have come to look upon a study of the gall-bladder as a definite indication for a study of all of the abdominal organs, and, for that matter, at least a fluoroscopic study of the chest as well. It is a much more complex matter than an examination, for instance, of the urinary tract, in which case nearly all of the stones cast positive shadows and the kidneys themselves are always outlined, so that any variation from the normal in size and position is easily noted. And then, too, the symptom-complex of urinary lesions is much more dependable than that involved in a gall-bladder lesion. And, again, any indication for a gastrointestinal study makes it imperative also that we make a definite effort to visualize the gall-bladder or demonstrate the presence of stones. The roentgenologist who limits himself to a few exposures of the gall-bladder region cannot hope to give full service to the patient.

Now, with regard to gall stones. From the roentgenographic point of view they may be classified as follows:

1. A single dense stone casting a uniformly dense shadow.
2. Multiple, fairly dense stones which, by their size, shape, position and arrangement, warrant easy positive diagnosis.
3. Collection of dense sand, giving a quite positive shadow.
4. Stones, frequently single, which contain only thin surface deposits of material dense enough to cast positive shadows.
5. Stones, usually multiple, which are definitely less dense than surrounding structures and which cast so-called "negative shadows."
6. Stones, usually multiple, which do not cast distinguishable shadows.

First, the single, uniformly dense stone always presents the problem of differential diagnosis between gall stone and kidney stone. The most dependable means of differentiation is by the injection of the kidney pelvis with an opaque solution under fluoroscopic observation, when, by palpation or the breathing motion or varying the angle of exposure, one may determine that the two shadows are in separate locations. Roentgenographically

varying the angle of exposure may settle the question, and if it can be shown that the kidney is not movable, a direct lateral exposure will often be sufficient to conclude the diagnosis.

Second, multiple, fairly dense stones are so characteristic in appearance that a diagnosis is immediately positive. We will show a number of cases of this type mainly to illustrate the variation in size, shape, number and density, and especially the variation in the location of the gall-bladder. They represent the most common type.

The next class—collection of dense sand—is relatively rare. It may be very small in amount or it may almost fill the gall-bladder. It is recognized by the rounded lower border of the shadow, taking the outline of the inner surface of the gall-bladder.

The fourth class—stones having only thin surface deposits that are dense enough to cast shadows—is an extremely important class from the viewpoint of the roentgenologist. The shadows may be extremely delicate and will be found only in films or plates of excellent quality and made with reasonably short exposures. This type of stone is fairly common. They are frequently large. Only careful search will at times reveal them.

The fifth class—stones, usually multiple, that are less dense than surrounding structures, so that they cast "negative shadows"—might be called, from the roentgenographic point of view, the speculative group, and one should be extremely careful to eliminate small collections of gas in the duodenum or colon as the cause of "negative shadows" before interpreting them as gall-stone shadows. They are much more apt to be shown in gall-bladders that contain very dense material or in gall-bladders with dense walls, so that in the immediate surrounding structures there is a tissue or substance of considerable more density than the gall stones themselves.

Of the gall stones in the sixth class—the stones that do not cast distinguishable shadows, either positive or negative—there is little to be said except that we always suspect their presence when we see a definite crescentic-shaped depression in the duodenal cap or some other portion of the gastrointestinal tract in the right

upper quadrant. We suspect this because it follows that a gall-bladder filled with stones will not be readily compressible.

The Potter-Bucky diaphragm has almost revolutionized roentgenographic diagnoses of lesions of the abdomen—particularly where the question of calculi is involved—and we feel that a very much greater percentage of gall stones can be found with the use of this diaphragm than was possible before it was perfected. In addition to this the intensifying screens have been improved very materially, so that they not only lend themselves to rapid exposures, but are practically free from glandular defects. And, finally, the film emulsion of today requires only half the exposure that was necessary a little more than a year ago. And, as a final step in the way of improvement, a larger number of roentgenologists are actually making an effort to demonstrate gall-bladder lesions.

The advantages of a roentgen-ray study need hardly be mentioned. The information is quickly obtained; it is painless; it furnishes evidence that can be weighed by means of the sense of sight; and it so frequently reveals the unexpected and the unsuspected that it seems hardly fair to the patient not to give him the benefit of such study.

A more comprehensive article on this subject by the author may be found in Dr. Lyon's book, *Non-surgical Drainage of the Gall-Bladder*, Philadelphia, Lea & Febiger, 1923.

DISCUSSION ON THE PAPERS OF DRS. DEAVER AND MANGES

Dr. C. F. Mitchell: I came here tonight, hoping to hear from Dr. Deaver how to diagnose early gall-bladder disease. I think, from the surgical standpoint, one of the most difficult diagnoses to make is this. Having listened to the second paper by Dr. Manges, it seems very simple now. However, in the early diagnosis of gall-bladder disease the surgeon very seldom sees the patient in the early stage. It is usually the clinician and the roentgenologist who make the early diagnosis. As to the treatment of gall-bladder disease, or disease of the upper abdomen, it seems to me that there are so many things like gall-bladder disease that

it is almost impossible to make a diagnosis, and therefore the treatment consists in a dietary one, particularly, and in watching for further developments. If a rule could be laid down as to when we should operate from the surgeon's standpoint, it would be very much simpler. One thing Dr. Deaver said interested me particularly, that is, the lesion of the gall-bladder itself very often started in the liver, and it was primarily a liver affection and not primary disease in the gall-bladder. If that is the case, I do not see why operation on the gall-bladder should cure the liver condition.

Dr. John H. Gibbon: The most interesting aspect of the gall-bladder question is the diagnosis, with which these communications have had to deal. We have gone beyond the stage where we have to have a clinical picture of gall-stone colic followed by jaundice in order to make a diagnosis of gall stones. Of course, there is some danger of going to the other extreme and making every case of windy indigestion one of gall stones. There is, in most cases, a clear-cut distinction between the gastric symptoms due to gall stones or gall-bladder infection and those due to ulcer or appendicitis. I believe that the most valuable means of making a diagnosis of an upper abdominal lesion is the history that the patient himself gives us—the description of his pain, its onset, its character, its reflection and its method of subsidence. The gastric symptom of gall-bladder infections and gall stones nearly always manifests itself as a sense of fulness and distention shortly after eating. The patient often tells you that he feels as if he had eaten a whole meal when he has eaten a half one, has to loosen the clothing, has a general sense of discomfort and is apt to describe the pain as going across the upper abdomen from right to left, with often referred pain to the region of the scapulæ or pectoral regions. This is not true of the other two conditions.

A history of typhoid fever I always consider very significant where a patient has gall-bladder symptoms. I think, from a clinical point of view, surgeons are inclined to believe that the infection comes from the gastrointestinal tract rather than the liver. Of course, we hope that it does, because if the source of infection is the liver the drainage of the gall-bladder or its removal would hardly cure it. The patient would go on suffering the same as he did before, whether he had his gall-bladder or whether he had not. Moynihan, in his characteristic way, has put the cause of gall stones in a nut-shell when he says: "A gall stone is a monument erected to the evil memory of the germ that lies buried within it." I think the diagnosis of these lesions is the most important phase of the subject, and the most interesting thing in the diagnosis is the advance made in the use of the *x*-rays, and I do not think that the value

of x-ray examinations in these cases can be exaggerated; even in the absolutely typical cases, in recent years, I have made it an absolute rule to have an x-ray examination. Even where you know the patient has gall stones the roentgenologist may discover other equally important and unsuspected pathology. You will recall one or two of the pictures Dr. Manges put on the screen showing both gall stones and kidney stones. I operated recently on a patient who had a number of small stones—hundreds; the man had a kidney stone removed some years ago. Such a case ought never to be operated on without an x-ray after operation to eliminate reformation of kidney stones. Although the x-ray is unreliable as to the diagnosis of gall stones, it is essential to employ it as we would any other method, particularly for the purpose of excluding other lesions. Of course, the interpretation of x-ray findings requires as much judgment as the determination of the necessity for operation. The clinical experience and judgment of the roentgenologist is of the greatest importance, because if he has not this clinical experience he is very apt to see things not there and to misinterpret what he does see. I was interested to hear Dr. Deaver say deformities lower down in the duodenum were more likely to be due to the extraneous lesions than to duodenal ulcer. Adhesions are due nearly always to something outside of the duodenum and not something inside. The duodenal ulcer has a perfectly typical x-ray picture as well as a typical clinical picture. There is another thing in the x-ray findings that I think is interesting: We used, in the earlier days of the x-ray, to receive very often a diagnosis of prepyloric ulcer. I have in so many cases found no prepyloric ulcer in these cases, but gall-bladder infections, that I finally came to look upon the diagnosis of prepyloric ulcer as being an indication of gall-bladder lesion. Now, an experienced roentgenologist interprets properly and tells you there is a hypermotility and persistent spasm of the distal end of the stomach and attributes it to something outside. It may be an appendix, but this hypermotility and this spasm, in my judgment, are much more common in gall-bladder than appendix infections or than they are in ulcer of the duodenum, excepting in early duodenal ulcers. I should like to ask Dr. Manges whether common duct stones are as frequently recognized as stones in the gall-bladder, because I cannot recall a single common duct stone that has been diagnosed as such by the x-rays, and I have operated on so many cases with enormous stones in the common duct where we had deformity in the duodenum but no shadow. Also, I think small gall stones are much more apt to show than the large ones. There is one other thing that Dr. Deaver spoke about that reminded me of mistakes I have made, namely, of operating on a hepatosis, thinking it was an enlarged kidney. I have not made the mistake in recent years, but I

have made it. These cases of hepatosis often, because of the position of the liver, cause an obstruction of the gall-bladder with typical gall-stone symptoms. I would like to say that when the patient passes a gall stone, unless it is an enormous stone, it is no indication that he is free of his trouble—it is rather an indication that he has other stones.

Dr. George E. Pfahler: I have been interested in the study of gall-bladder disease really for about twenty-two years, and especially in the diagnosis of gall stones. For about ten years I have made it a routine in every gastrointestinal study to make a study of the gall bladder, and I believe this should be done practically without exception. In my own experience I find more evidence of gall-bladder disease than I do disease of the stomach, and when a doctor calls up and asks for an examination of the stomach, I really hate to confine my examination to the stomach, and very rarely do. I do not think I make half a dozen stomach examinations limited to the stomach in a year, and I do not believe it should be done. When any case is sufficiently obscure to demand a gastrointestinal study, then it is sufficiently obscure to do it thoroughly. A thorough study of gastrointestinal tract means all the stomach, the duodenum, the gall-bladder region, the appendix and the colon, and if you go over all these organs thoroughly, you can give the clinician a great deal of valuable information, both positive and negative. As to gall-bladder disease, I can only emphasize what Dr. Manges has said. We have the direct evidence of gall-bladder disease and indirect. In the direct evidence we show, at times, the gall stones and at times a direct shadow of the gall-bladder. In the indirect evidence we have the displacement effect of the enlarged gall-bladder, and we have the adhesions of the surrounding structures to the gall-bladder, particularly the duodenum, which is fixed in position, and it may or may not be deformed, but it is fixed in position. It is an important point in diagnosis. Now, the other indirect evidence which we get and which is very valuable, is the diagnosis by elimination. If we go over the stomach thoroughly and find it normal, we find the duodenum normal, and if we find no tenderness, no retention or adhesions, and no irregular retention in the appendix, and if we find the colon normal, if the patient has symptoms, then even slight evidence pointing toward the gall-bladder direct, the negative evidence on other organs is of importance. For instance, if we find enlargement of the gall-bladder and everything else negative, we have pretty strong evidence that the gall-bladder is the cause of the patient's symptoms. So, too, if we get indefinite shadows of gall stones and everything else negative, then we can feel reasonably certain that the gall-bladder is involved. One other point I would like to refer to, and Dr. Gibbon mentioned this, that is a great

deal depends upon the thoroughness with which this work is done, not only the interpretation, but the work itself. I find so commonly in cases referred to me second-hand that there has not been sufficient work done on the case—real manual labor, real technical work. There has not been enough study done, not enough films made. Dr. Manges has done a great deal more work on each case referred to in his discussion—he has made from twenty to thirty films of each one of these patients. He shows you the best one, the one that shows most clearly the disease. He does not confine himself to making a single film. I do not think he does, and I never do make a single film. I rarely confine myself to the gall-bladder. I believe we should not confine ourselves to making films of the gall-bladder region, but should also study the stomach and duodenum in relation to the gall-bladder, and I think we should go down farther and study the appendix, because the symptoms, as I hear the patient describe them, are similar. Then the study, the interpretation of these films after they are made—it takes a great deal of study. Those that are shown clearly, like some Dr. Manges has thrown on the screen, you can pick these up quickly. There are others you study, dozens of films, to see whether you can duplicate the shadows in more than one film. Frequently we must hold the film in an oblique position to see the shadows. It is not quite as easy as it appears from this demonstration, which is a hurried demonstration of a great deal of work.

Dr. John H. Gibbon: There is one thing I want to express at least some doubt about: I am afraid if we are going to interpret every visible gall-bladder visible in the *x*-ray plate as a "pathological gall-bladder" we may make a mistake. We are seeing these gall-bladder shadows much oftener with improvement in the rays, the plates and the method of examination. I do not believe we should accept without question, the mere visualizing of the gall-bladder as absolute evidence of a diseased gall-bladder. It may be the case, but we are not ready to accept it at present.

Dr. Milton F. Percival: There is very little left for me to say in discussing the very interesting paper of Dr. Manges, because he leaves very little to say that should have been said. I am glad that he touched on the indirect evidence of the diagnosis, especially on the duodenum and even adhesions of the colon. Dr. Pancoast, in 1917, here in this room, had a discussion very similar to our present idea of diagnosis: First, direct evidence, visualizing of gall stones, and second, indirect evidence. If the gall-bladder can be visualized it shows there is some thickening present. An inflammatory condition, adhesions outside of the duo-

denum, or about the gall-bladder, are more apt to be from gall-bladder or some adjacent inflammatory adhesions than from within the bowels. I would like to show two slides which illustrate my point. You can miss a big gall stone and you can also spot them in situations you hardly think it is possible to find them. The second case is very graphic.

Dr. Hobart A. Hare: This discussion, so far, has given us an immense amount of light along certain lines, but very little aid of direct benefit to the average medical man, except, possibly, the fact that Dr. Manges has impressed upon our minds the fact that very much better results can now be obtained from *x*-ray examinations than a few years ago. The point I wish to emphasize is that, after all, most of these cases come to the surgeon through the physician's hands, and it is really up to the physician to make the primary diagnosis, and in making that diagnosis he takes the responsibility when referring the patient to the surgeon. He takes an additional responsibility in that every medical man of large experience has met with cases in which, after operation, the last state of that man, meaning the patient, is worse than the first. That does not mean in any way that I wish to reflect upon what the surgeon can do, or his skill or any intention of intimating that he does not use good judgment.

I have no intention of rolling the Apple of Discord among the surgeons by bringing up the question whether the gall-bladder should be taken out or whether it should be opened and left in. I know, from experience, that when the gall-bladder has been opened and drained, the patient suffered a great deal afterward from various causes, and when taken out he has suffered a great deal afterward from various causes. Some cases where cholecystectomy is done do badly and some do well, and the explanation lies in some of the recent researches on the sphincter of Oddi, and the ability of the common duct to play the part of secondary gall-bladder. When the sphincter of Oddi is strong enough, or hypertrophies enough, to restrain constant dribbling of bile the common duct dilates, acts as a temporary gall-bladder and these patients do splendidly. Of course, the surgeon has no means of telling which is going to happen; the discomforts which the patient has suffered heretofore are replaced by those due to constant entrance of bile into the small intestines and not the ordinary methods of expulsion. What I would like this discussion to bring forward more clearly is one point which was emphasized by Dr. Mitchell, How are we going to make the diagnosis, not of gall stone or sand or thickening of the gall-bladder, but what are the signs which are going to tell the general medical practitioner that the case is a surgical case? Now, I do not mean by that to intimate that these gall-bladder cases are medical cases, for some surgeons think they are either surgical or they are nothing, but I

do mean that I do not think the medical man can do very much. I am confident that I have seen a number of cases where gall stones have had no more pathological significance for the patient than the fact of having gray hair after he had lived a certain number of years. When they begin to erode the mucous lining of the gall-bladder, then I think, without doubt, the case becomes a surgical proposition. I go further than that (I am answering my own question now), I think the medical man who has a patient coming to him suffering from constant, annoying abdominal distress in the upper abdominal zone should be opened up, and the physician should say to the patient: "I know of no medical means that will relieve you of this distress. The *x*-ray may have failed to show that you have gall stones, possibly you have adhesions, but I believe you have got to decide for yourself. If you are suffering sufficiently to make you willing to have an operation, then I strongly advise it."

Except for gross errors in diet, I do not believe that dietetic treatment has much importance in the presence of gall stones.

Dr. B. B. Vincent Lyon: After hearing these papers of my friends, Dr. Deaver and Dr. Manges, I have come to the conclusion that there is still much to be learned in Philadelphia (as well as in other cities) in regard to early diagnosis of gall-tract disease. It is a very encouraging sign, however, that we are beginning to take more interest in the *early* diagnosis of gall-tract disease, as evidenced by the excellent papers presented tonight in this symposium, because if we wish to make a really forward step in the management of late gall-tract disease, we must learn to recognize the disease in its incipiency.

Of the excellent *x*-ray pictures which Dr. Manges showed on the screen, practically all of them are instances not of *early* gall-bladder disease, but of disease well established, as representing pathological gall-bladders, gall stones or adhesions. When, therefore, a patient has recognizable calculi, a visible pathological gall-bladder or roentgenological evidence of adhesions, it represents disease that has existed for some time. Such disease can be recognized at a much earlier stage by the methods which I have been advocating. If you are not all familiar with them, and you certainly should be by now, for they have been written about, spoken of, and freely discussed for several years, it is largely your own fault.

Diagnosis by means of gall-tract drainage through the duodenal tube will provide accurate information that will detect the early states of pathological physiology, or early disease involving the mucosal surfaces of the gall-bladder or ducts, dysfunctions or abnormalities within the liver, in addition to the evidence of collateral findings within the duodenum. It is perfectly possible today, therefore, to detect early disease of the

gall-tract *in toto* and to make such diagnoses consistently, day after day, being sure of what you are doing and able to demonstrate the actual findings to anyone interested enough to come around and look with his own eyes.

In regard to well-established disease of the gall-tract, it furnishes to the clinician, or to the physician, intimate diagnostic data that is of great importance in the correct management of the patient, such as obstructions of the common duct or the cystic duct, and furnishes explanations or interpretations as to the nature of the type of obstruction, and can, therefore, offer a practical alternative of management in selected surgical cases that has during the past years increasingly been proven successful. Unfortunately, it is much more difficult to illustrate such findings on the lantern screen than is the case with the roentgenologist, nor can we demonstrate the actual pathological tissue in the laboratory after it has been taken out of the abdomen as can the surgeon. Nevertheless, it is possible to exhibit the microscopical cytology, gross alterations in the bile and the cultural identity of the infection producing the process.

Dr. Pfahler has pertinently pointed out the value of studying the gastrointestinal tract in a total sense by means of the *x*-ray. It is just as important that emphasis should be constantly made of the necessity of studying the gastrointestinal patient by means of a complete diagnostic survey. In all chronic forms of gastrointestinal disease, and in many cases of acute forms, a total study of the patient will bring out several major diagnoses and many associated collateral diagnoses. It is not simply appendicitis, duodenal ulcer or gall-tract disease. In many cases all three of these conditions may simultaneously exist, and may have been produced by extragastric infection within the tonsils, teeth, gums, sinuses or bronchial tree—less frequently from the colon, prostate or pelvic organs. Dr. Manges has stated his similar belief in the demonstrability of multiple lesions existing in the same patient as shown by means of the *x*-ray. It is my opinion that lesions so demonstrable by the *x*-ray represent a later pathological stage.

Of course, history and physical examination are fundamental steps in diagnosis and can never be disregarded. Dr. Gibbon has said he would rather base his opinion upon the history than any other one diagnostic maneuver. I, too, depend on the value of a properly taken history, provided the history is intelligently taken and interpreted. That a patient who is "fair, fat and forty and belches gas," means gall stones may be true in a general sense, but it does not represent early diagnosis to wait until after gall stones have been formed. After analyzing several hundred carefully taken histories, I doubt whether there is any clinical historical picture group that will define the presence of every case of early gall-tract

disease. Suggestive pointings may be secured, but not definite diagnosis. Most of them do not have pain at this stage. Dr. Hare has substantially expressed this same opinion.

To history, therefore, has to be added careful physical examination, which, in turn, may be practically negative, and various indirect laboratory examinations of blood, stools and urine, which also may furnish the merest diagnostic leads. *X*-ray examination in the *early* stage of disease will show nothing and cannot be expected to do otherwise. We therefore have to fall back upon the proper use of the duodenal tube in studying the stomach, duodenum and gall-tract, but this must be done intelligently and with a real knowledge of how to do it. But when properly carried out, it will supply the evidence sufficient to recognize the beginnings of gall-tract disease far earlier than by any other single method of examination.

As regards the treatment of gall-tract disease, we can drain out and remove pathological bile just as adequately, if not better, through the duodenal side of the common duct as can be done through the abdominal route by way of the gall-bladder, provided the cystic duct is not obstructed. In the latter event we can, in most cases, drain only the major excretory ducts and the liver. Diagnostically, it is worth something to demonstrate a cystic-duct obstruction. It then becomes necessary to define the nature of this obstruction, whether from adhesions, stone-block from within, mechanical obstruction from without, and, finally, and most commonly, from inflammatory edema and catarrh within the cystic duct. Such a differentiation can usually be made. The microscopical picture of cystic-duct obstruction from within, due to catarrh, is uniformly the same. Where this microscopical finding is secured, it is usually possible to unblock this type of obstruction by the third, fourth or fifth non-surgical drainage, and, thereafter, the conditions as regard infection, inflammation or calculi within the gall-bladder itself can be estimated. Such types of cystic duct obstruction, as well as that produced by physiological block, are no longer primarily surgical, and nothing else, inasmuch as patients so afflicted can be restored to health by the technical but non-cutting procedures which I am using, and without any surgical traumatic or mortality risk. This I have demonstrated over and over again as an actual fact. As regards catarrh still existent in the ducts (recurrent cholangitis) after removal of the gall-bladder, this method is certainly the procedure of choice rather than secondary operation, unless there are obstructive adhesions. Sound judgment must be used in the selection of cases for whom this method is definitely impractical.

The great field in the future lies in the possibility of benefiting many types of disorders and disease within the liver itself by non-surgical drainage by way of the duodenum.

During this last week Dr. Manges has succeeded in scoring a point for the usefulness of this procedure. Before starting a patient, who had gall-bladder and duct disease, upon an intensive period of continuous drainage, he *x*-rayed this gentleman and reported a very easily demonstrable pathological gall-bladder of the type of which he has spoken of tonight. I gave this patient five days of continuous drainage by duodenal tube, day and night, and thereafter fifteen hours of continuous drainage out of each thirty-six, covering a total period of sixteen days, during which time two and a half gallons of bile were removed from this patient without discomfort. There was immediate arrest of all symptoms, and the objective findings of mucous shreds, pus cells and microscopical evidence of inflammation in his bile gradually disappeared, day after day, until no longer found. At the end of this time this patient was again referred to Dr. Manges, who informed me that on reëxamining him he was greatly surprised at the difficulty in demonstrating this gall-bladder, that its visibility was distinctly lessened and that it was decidedly smaller. This patient was discharged clinically improved from every standpoint, quite as much so as if he had been discharged from the Lankenau Hospital after surgery, in a much shorter period of time, and with much less discomfort to the patient and the avoidance of a minimum 3 per cent mortality risk, and of all the postoperative surgical calamities.

Dr. Deaver (closing): There is little left to be said. The discussion has covered practically the whole territory. Dr. Hare wisely said, "How about the doctor?" I am glad to say the majority of cases that come to me have already been diagnosed. With Dr. Gibbon, I agree that the history is a very important point in the make-up of the diagnosis.

In these early cases I question—with all due respect to our distinguished *x*-ray gentlemen, who have shown off to advantage tonight—if they are of much assistance. My friend, Dr. Lyon, has added something from a diagnostic standpoint, although I would not say from the curative standpoint; but I do believe these cases that give a distinct and definite history with an absence of physical findings, should be given the advantage of *x*-ray as well as of tube drainage, but in the end they will come to the operating-table where truth will be revealed. You might think, from what these distinguished roentgenologists have said, they have said the last word; not so. That which I rely most upon is history and palpation.

My paper was to bring out the fact that I believe the majority of these cases are infected through the liver. I am sorry that my distinguished colleague, Dr. Reimann, is not here, to whom is due much credit. We have worked hand-in-hand. I give him the material and he draws conclu-

sions from his very careful bacteriological and pathological studies. There is no question in our minds that in the majority of these cases infection comes by way of the liver. My friend, Dr. Mitchell, says if the liver is diseased, what good does it do to take out the gall-bladder? The liver is not diseased, it is infected. We know what a masterly organ the liver is. Look how it takes care of so many other organs. A little bit of infection of the liver does not mean anything; it takes care of it. If the infection reaches the gall-bladder it is a different matter. This little innocent organ, with practically no defence at all, cannot take care of itself as can the liver; and, further, it conveys infection through the lymphatic chain to the pancreas, which suffers in time.

Dr. Manges (closing): I would like to touch on one of the indirect signs, gastric spasm. I assure you we do not any longer take gastric spasm as evidence of any one thing until we rule out the possibility of organic lesion of the stomach itself. We frequently have to put the patient on an antispasmodic, preferably belladonna, for a few days in order to determine definitely whether there is or is not a lesion of the stomach. If the spasm is entiredly relaxed we are able to show the lesion of penetrating ulcer, or even very early infiltrating lesions in that region of the stomach. If they are purely spasms they are not indicative of intra- but extragastric disease. In regard to common duct stones: Personally, I have never been satisfied that I knew where the common duct was. I am not sure that some of the gall stones that I have shown and differentiated from kidney stones were not in the common duct. Unless I see the outline of the gall-bladder itself, and unless I see the collection of stones which by their size, shape and arrangement indicate that they are in the gall-bladder, I say they are gall stones—they may be in the cystic duct, the gall-bladder or anywhere. I have tried to demonstrate that it is the large single stone we have the most difficulty in demonstrating; that we only demonstrate it when it has on its circumference some little deposit of calcium material. That is the gall stone we are after. That is the thing we are bending our energy to discovery more frequently. We are doing very much better than a few years ago, and who knows that we may not do better still? I am sure that common duct stones have been diagnosed by the *x*-ray. I am sure that Dr. Pfahler has done it on a number of occasions. I have heard him tell about it and seen his slides, and there are a number of cases in the literature. Again, I would like to emphasize this point of multiple lesions: Why pick on the gall-bladder alone when there may be one, two or three or more important lesions in the abdomen or chest? Only two or three days ago I had a poor, unfortunate fellow who had a perfectly definite gall-bladder lesion, but also had an early

carcinoma of the esophagus. What good is it going to do to remove his gall-bladder? Another instance I recall, where a patient was sent into the hospital for operation for carcinoma of the stomach. Well, it was perfectly plain that he had an extensive organic lesion of the stomach, an infiltrating type of lesion producing a large filling defect, but they had overlooked the fact that he had a large aortic aneurysm. In examination of the gall-bladder I do not examine the gall-bladder only. I examine the entire abdomen and always fluoroscope the chest, because pathology in the lungs or mediastinum that is at all advanced is readily recognized by the fluoroscope, and if we are in doubt as to the presence of a lesion or suspect a lesion in the chest, we make careful stereoscopic films and study them. Now, as to the positive gall-bladder shadow. Does it indicate pathology or not? I have made the assertion that no one has proved that it does not indicate pathology. It is a thing that is found sufficiently frequently, so that any surgeon interested in gall-bladder lesions should, when he sees fit, operate on patients of this kind, make an extremely careful study of the gall-bladder as well as of the walls of the gall-bladder itself. I would like to confirm the remarks of Dr. Lyon in regard to the patient I recently examined, and this man, by the way, was over six feet tall and weighed 225 pounds—a very large and solid man indeed—and we got just as positive a shadow of his gall-bladder as any we showed on the screen, and it was perfectly clear on reëxamination that the gall-bladder was smaller and less dense.

SOME QUESTIONS OF THYROID AND HYPOPHYSEAL PATHOLOGY

The Mary Scott Newbold Lecture

Lecture XII[1]

By PROFESSOR A. BIEDL
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The historic development of our knowledge of internal secretions and the predominant tendency in medicine to localize a disease in a definite organ furnish an explanation for the fact that even today the symptoms of endocrine diseases are often interpreted as consequences of the functional disturbance of but one single gland, and we unwarrantably endeavor to find the specific gland presumably at fault. Of course, as early as the 90's statements were made that more than one gland might be involved, as, for example, that in acromegaly other glands outside of the involved pituitary played a rôle, such as the gonads and the thyroid.

A general interpretation of endocrine diseases on the basis of their pluriglandular genesis was at that time hardly possible on account of the lack of exact physiologic data. Gougerot's conception of polyglandular insufficiency, announced in 1909, did not alter the situation for the reason that such of his syndromes as thyreo-supra-renal-ovarian or hypophyseal-thyreo-testicular represented mainly only a summation of components of their essential relationship. When Falta and Wiesel announced, respectively, the ideas of a pluriglandular sclerosis, and of a general

[1] Read March 5, 1924.

connective-tissue diathesis, a step forward was taken toward recognizing a homogenous and simultaneous pathologic alteration of several glands or of the whole endocrine system as the result of either a constitutional diathesis or possibly of an infection. Pluriglandular sclerosis and connective-tissue diathesis, as actually found in some of the cases, however, have as their common basis only a *pathologico-anatomic* change manifest in several of the glands which are genetically or structurally related. The *functional* relation was not taken into consideration, in spite of the striking fact that the structural changes were accompanied by a functional insufficiency in some glands and by a hyperfunction in others.

The pathologic physiology of the endocrine system, that is, the exact analysis of the pathogenesis both of polyglandular and specific glandular diseases, must be based upon the broad general fundamentals of (1) the genesis, (2) the structure, and most important of all (3) the functions of the endocrine glands. It is essential to investigate the close functional correlations and interrelations of the different endocrines, and both their coöperative and antagonistic actions in the various organs of the body. It is, furthermore, necessary to take into account the fact, confirmed more and more by recent investigations, that the correlated endocrines not only influence, but in turn are influenced by the nervous system, and indeed by all the organs and tissues in the body. In other words the endocrine system is but one part of an intergrating arrangement which secures for the individual undisturbed life and activity, adequate for all requirements, and assuring both individual life and preservation of species.

On this basis a discussion of endocrine diseases, as those of thyroid or pituitary, must embrace the following topics: (1) Their position in the whole endocrine system; (2) the control of their functions in various organs by other endocrines and by the nervous system; and (3) the importance of autonomy of organs and tissues as dependent solely upon physicochemical conditions. In a sick individual we can very well see how the pathologic alteration of but one organ upsets the equilibrium of the entire system, and how reactions to the pathologic process, expressed in symptoms, course

and outcome of the disease, are determined by the general constitutional habitus of the patient. In centering the attention on one gland and failing to appreciate interrelationships there has resulted, in my opinion, the existing discrepancy of views concerning pathogenesis.

Obviously it will not be possible for me to cover the entire subject in the limited time at my disposal. I shall discuss only some phases of the physiology and pathology of the thyroid and hypophysis.

The first question is: How far does morphology in its broadest general sense, that is, comparative embryology and anatomy, normal and pathologic histology, explain the genetic and structural relationship between thyroid and pituitary? Whether or not this information warrants the supposition of functional interaction?

The thyroid originates from the entoderm by a median outgrowth of the lining of the pharynx floor. The participation of ectodermal structures, such as the branchial pouches, in the formation of the lateral thyroids is not as yet established. Organo- and histogenesis transform this originally externally secreting gland into a new organ, composed of follicles and interfollicular tissue capable of forming new follicles. This is an important fact. Without its proper appreciation it was assumed that the follicles represent the remnants of the active embryonic gland, and that the filling up of the follicles with the colloid substance is the natural continuation of the function of the embryonic gland in postfetal life. The loss of the excretory duct, it was falsely assumed did not cause any other change but a retardation in the delivery of its product, the colloid substance, looked upon as the internal secretion of the adult gland. Studies of the excretory passages of the colloid led into a blind alley. Pathologic studies easily demonstrated that abundance of colloid did not signify increased secretory activity but rather indicated a decreased function.

The true nature of the secretory process of the thyroid, first proposed by A. Kohn, in Prague, and later confirmed by Bensly, in Chicago, is as follows: The epithelium of the thyroid possesses a polarity opposite to that of other gland cells and delivers its

product primarily into the bloodvessels rather than into the lumen of the gland. The more active the gland the quicker it delivers its product into the bloodvessel. Only the unrequired surplus is stored in the follicles. There it might undergo chemical changes decreasing its physiologic potency. We urgently need a better understanding of the existing relations between the chemic and morphologic processes of production and output of the active principle. Baumann's discovery of iodine in the gland (1894) and Kendall's finding of thyroxin and his studies of its chemistry, on the one hand, and Bensly's histologic studies on the other, will have to be correlated.

Recent investigations, made in my laboratory, deal with the distribution of iodine between the cells and the follicular contents, as compared with the iodine contents of the whole thyroid and the blood. In this manner we hope to reveal important details regarding endocrine function. From the pathologic point of view it is highly important to recognize this new conception and to realize that such recognition demands a reconsideration of the interpretation of histologic findings. We must remember the indisputable fact that goiter, in reference to function, may mean nothing or very much; in the latter case it may mean hypofunction or hyperfunction, and even a third possibility, that indefinite something called "dysfunction." We must evaluate anew the histologic picture, employing all the latest methods of microchemistry, in order to establish new standards for the different phases of functional activity.

Examining recently several series of pathologic thyroids, I found striking structural differences in the various parts of the same gland. The tendency was strong to assume variable functional activities. I wonder whether we do not fall into the mistake of schematizing a gland as uniformly normal or as hypo- or hyperactive in its function. These different stages of function may exist in the same gland in its different parts simultaneously.

As to the pituitary the morphology is as follows: Recent embryologic investigations prove the conception of their purely ectodermic origin to be wrong. The hypophysis originates from

four primary indentations of the pharyngeal wall and the head end of the primitive gut. (Two ectodermal pouches form respectively the *pars tuberalis and the pars intermedia.* Two entodermal pouches form the *pars anterior.*) Anatomically we must divide the hypophysis into three endocrine segments, and if we include the *pars posterior nervosa* and the stalk, into five parts. The internal secretory parts are: the anterior lobe or prehypophysis, representing a gland of growth; the *pars intermedia* or *juxtaneuralis*, influencing metabolism and third, the *pars tuberalis*, lying on the *eminentia saccularis* on the *tuber cinereum*, the function of which is still to be determined.

Concerning the secretions of the pituitary, I may state, briefly, that the anterior and tuberalis discharge their product into the bloodvessels, and that formation of follicles and their filling up with colloid is merely an accessory storage. Here is an analogy to the secretory mechanism of the thyroid. The product of the pars intermedia does not pass directly into the blood stream but through lymph spaces of the connective tissue of the pars posterior and hypophyseal stalk into the cerebrospinal fluid. The relationships between the hypophyseal and thyroid secretions have not yet been studied. Iodine in considerable amounts has been found in the pituitary—a remarkable fact indeed. The morphologic interrelation between thyroid and pituitary is apparent from the fact that a hypertrophy of the pituitary follows any deficiency of the thyroid (such, for example, as congenital aplasia or experimental removal of the gland in animals). On the other hand the extirpation of hypophysis or of some of its parts in animals as well as the operative diminution of the enlarged gland in cases of acromegaly (Hochenegg), is always followed by a change in the structure and volume of the thyroid. Physiologic studies of both glands will eventually answer the question as to the possible functional relations existing between them.

Out of the complex functional activities of these two glands I shall mention only those referring to skeletal growth, body development, development and function of the gonads and to the general metabolism.

Bone growth is a most complicated process, quantitatively depending on a sufficient supply of materials, and qualitatively (in shape, size, form and time) determined by hormones of practically all the endocrines. It is generally known that longitudinal growth is practically finished at the time of the maturity of the gonads. After that changes are limited to lateral expansion from the deposit of new periosteal bone. For this reason immaturity of gonads is essential for activation of any stimulus toward bone growth in length. In regard to the height growth periods of humans we have to assume that any considerable increase in height, reappearing periodically, is correlated with changes in the functional ability of the gonads. We cannot decide, however, whether such a functional revolution of the gonads, *i. e.*, in prepuberty, has to be regarded as cause, effect of or coincidental with hastened growth. We shall not consider the other endocrines in connection with formation and growth of the skeleton, although we must bear in mind that parathyroids and thymus have a close genetic, topographic and functional relationship to thyroid and hypophysis. We know that both of these glands during infancy and incompleted growth, if absent or deficient, inhibit growth resulting in dwarfism. Hyperfunction of both is accompanied by overgrowth of the skeleton.

The interesting fact must be emphasized that a deficiency of either thyroid or pars anterior of the pituitary results in an inhibition of the maturation of the gonads, and in spite of these seemingly favorable conditions for length growth the actual occurrence of dwarfism in such cases is the more striking. An acceptable explanation of this discrepancy might be found in the fact that the hypoplastic gonads of such an individual are incapable of the periodic changes essential for the periodic length growth phenomenon.

As to the bone changes in cases of hypothyroidism, I wish to state that growth inhibition is invariably accompanied by structural bone changes.

In cases of experimental lesions of the pituitary, and in diseases of the anterior lobe, we observe an arrest of skeletal growth.

I demonstrated this in my own cases by *x*-rays. But this inhibition concerns bone growth in all directions with the result of a hypophyseal ateliosis. The significant feature of ateliosis is the fact that the individual almost perpetuates his external status as it was at the time of the onset of the disease. After a shorter or longer time, however, he manifests the evidences of presenility, such as we see in all instances of infantilism. Bone growth is almost completely stopped in all directions. Thus we can explain that cases of hypophyseal ateliosis, preserving a delicacy of bone structure together with a semblance of adult form, are often considered as primary dwarfs (nanosomia primordialis). These individuals make their strongest appeal as human miniatures on the stage. Athyreotic dwarfs are easily recognized by their infantile proportions and coarse bones, by their mental deficiency and by their peculiar skull formation and physiognomy.

Noteworthy differences can also be observed in cases of hyperfunction of thyroid or hypophysis. Hyperthyreosis of adolescent age manifests itself in the abnormal length of the long bones, a fact definitely established by the measurements made by Holmgreen and readily demonstrable in the striking length of phalangeal bones. I have been struck for some time by the slender stature, by the thin extremities and the long hands and fingers of the Basedow patients. I have marveled at the power of observation of that master artist Boticelli, when I noticed that the necks of so many of his tall and slender figures suggested the presence of an enlarged thyroid. Whatever position one takes in the Basedow problem, whether or not one opposes an exophthalmic goiter or a dysthyreosis to a toxic goiter or a simple hyperthyreosis (my position on this question I shall give later on), the one thing is certain, namely, that this abnormal increase of the long bones is a clinical fact, the explanation of which requires nothing else but a thyroid hyperactivity. A surplus of thyroid hormones causes abnormal length growth of long bones in adolescence, in an adult with bone growth finished, such a result cannot ensue. In them, however, a careful *x*-ray or histologic examination of the bones might reveal on increase in either osteoblastic or osteoclastic activity.

A hyperfunction of the anterior lobe of the pituitary is assumed to be the cause of skeletal overgrowth and gigantism, because in all these cases there is found a hyperplasia or new growth like adenoma or adenoma carcinoma in this lobe. One may quite justly challenge the French interpretation of acromegaly and gigantism as different expressions of the same pathologic stimulus, leading to gigantism when active in embryonic and early post-embryonic life, resulting in acromegaly when exerting its influence after puberty when longitudinal bone growth has definitely ceased. It is certain that this essential difference exists: In gigantism the increase in bone growth occurs in all dimensions and in all bones, though the skull as the result of early synostosis remains small, but its bones become markedly thicker. On the other hand, in acromegaly chiefly and solely the increased thickening occurs at the peripheral ends of the bones of face and extremities, accompanied by a striking hypertrophy of the connective tissues of the soft parts. Two years ago I advanced the hypothesis that the differences in these growth types may be due to involvement of different cell types in the anterior lobe. It is possible that the chromophobe main cells are responsible for the hypertrophy of the soft parts, as we see it in the acromegalic changes during pregnancy while the eosinophiles are responsible for periosteal growth and the basophiles for enchondreal growth. However, that may be, we cannot disregard the fact that in cases of thyroid hypofunction bone thickening takes place to a smaller degree, while in cases of hyperfunction of the anterior pituitary the thickening is more pronounced. On the other hand, in anterior lobe deficiency and in hyperthyroidism the bones preserve their delicate structure. An increased length growth is seen both in hyperthyroidism and hyperpituitarism, by which I imply an overfunction of the anterior lobe.

We might be justified in drawing the following conclusions: Normal thyroid function presides over length growth, influencing in a small degree lateral growth, which is actually determined by other endocrines. Bear in mind the hypertrophy of the pituitary in athyreosis. The anterior lobe of the hypophysis regulates in a

small measure the length growth, but determines the activity of periosteal ossification and growth of the soft parts. Further studies will have to confirm, disprove or amend this hypothesis. It is obvious, however, that the functional connection between thyroid and hypophysis cannot be expressed simply by the term synergism or antagonism, their correlation being much more complicated.

This same complex situation presumably exists also in regard to the influence of thyroid and pituitary on the gonads. The hormone control of the gonads is not by any means limited to thyroid and hypophysis, since evidently also the suprarenals, especially their cortical parts and the so-called interrenal system, the thymus and the pineal body are connected with sex development and sex function. Without doubt the gonads are stimulated in their development by every part of the body, but the effects of this stimulation manifest themselves only progressively in time. The gonads themselves regulate and direct the development of the whole body. Corporal maturation runs parallel with gonad maturation. The influence of the thyroid and hypophysis over the gonads is to be regarded primarily as a part of their activity in general body development. Deficiency in thyroid and anterior lobe activity result in an inhibition of general development and thus in retardation of gonadic development, leaving them in an infantile stage. The incomplete development of secondary sex characteristics is obviously an inevitable result of this complex. Owing to the scarcity of observations of prepubertal hyperthyroidism and hyperpituitarism it is impossible to say whether an overfunction of thyroid or hypophysis is responsible for an increased gonadic development.

In addition to this general influence we must assume a special influence on the basis of certain experimental and clinical observations. Experimental thyroidectomy in young animals leads to genital aplasia with degeneration of the germinative elements. Hypothyroidism in humans is associated with genital disturbances due to degenerative processes in the gonads. Experimental removal of the pituitary, not limited, of course, to the anterior lobe but necessarily including the pars intermedia, in adult animals,

results in pronounced degeneration of ovaries and uterus, of testicles, prostate and seminal vesicles. In young animals these changes are more marked because these retrograde changes affect an underdeveloped organ. Many reasons, not to be enumerated here, lead me to the supposition that the inhibition of development is due to the deficiency of the anterior lobe, whereas the degenerative changes and the genital dystrophy are caused by insufficient function of the pars intermedia. It is for this reason that hypophysectomy, as usually done in animals, cannot produce the clear-cut picture of arrest of genital development and growth, nor can we produce a true adiposogenital dystrophy, but a combination of both.

Berblinger, from an anatomic point of view, recognized in man a developmental arrest of the testicles with consecutive atrophy as the result of hypofunction of the anterior lobe. General dystrophy in Froehlich's syndrome has a different origin. It is a consequence of scarcity or lack of pars intermedia secretion. Its causes are: tumors in the region of the pituitary, other brain tumors, hydrocephalus and other conditions leading to increased intracranial pressure. As an additional cause I described two years ago primary developmental inhibition of the brain. General arrest of development and growth does not belong to Froehlich's disease.

Turning next to the inverse influence of the gonads on thyroid and hypophysis, the effect of gonadic underdevelopment on gigantism and acromegaly is obvious from the fact that genital hypoplasia or castration, as well as pregnancy, cause a hypertrophy of the pituitary. The relation of hyperthyroidism to gonad function is evident. Hyperthyroidi m is seen six times more often in women than in men. Onset of thyroid hyperfunction at puberty, during pregnancy and lactation, is common and hyperfunction is likely to cease with the end of lactation. Careful analysis of the early stages of hyperthyroidism reveal often primary disturbances of ovarian function, such as amenorrhea or menorrhagia. Signs of increased libido and increased sexual activity occasionally precede the first symptoms of the disease. These are facts of

importance for therapy because in my experience hyperthyreoses of this type often respond to proper treatment of the ovarian functional disturbance.

Discussing next the hormone control of metabolism we enter a field, well cultivated and fertile, at least as far as the thyroid is concerned, but obviously much work is till to be done. Thyroid substance increases basal metabolic rate, and the determination of this rate is rather generally employed in this country as a test of quantitative alteration of thyroid activity. I am personally convinced of the usefulness of this test and have advocated its more general use in the clinics of our country. But we must remember the possibly misleading errors of any routine test, especially in regard to metabolism which is the complex result of so many different and ever-changing processes of all living tissue. There are relatively large and unavoidable sources of error in the methods of determination of the metabolic rate now commonly used. Often the required standard conditions for basal metabolism are not observed because they are dependent upon a better coöperation of the patient than can be obtained. For clinical purposes the spirometric method might prove sufficient, for exact scientific investigations the respiratory chamber or the respiratory calorimeter is indispensable. I warn you against overestimation of the basal metabolic rate, it is certainly inferior to well-observed clinical signs. In the presence of symptoms of hypo- or hyperthyroidism a corresponding metabolic rate will be a welcome confirmation of the diagnosis, but contradictory figures should never overthrow a clinical diagnosis.

I wish to emphasize that in our present manner of investigating metabolism we are gradually more and more disregarding the various single components of metabolism. A better understanding would require closer information concerning the difference of reaction of various combustible substances to the increased oxidation effected by thyroxin. Furthermore, a question arises in regard to the significance of thyroid secretion for the specific dynamic action of different food substances. I had investigations made in my clinic concerning this specific dynamic action of sugar

in cases of hypo- and hyperthyroidism. In both conditions we found a deviation from normal, always turning toward the normal level with an improvement of the disease. We shall study in the same manner other foodstuffs.

In individual cases, but so far not systematically, also has been investigated the influence of normal and abnormal hypophyseal activity on basal metabolism and on specific dynamic action. No definite conclusions are yet available. Our own observations failed to confirm the claim of Kestner that certain changes in the specific dynamic action of proteins have value in the diagnosis of decreased hypophyseal activity. I assume that this difference in our results might be solely dependent upon a difference of opinion as to what constitutes hypophyseal insufficiency. As already stated the pituitary comprises several component parts with endocrine function, any one of which may be deficient. Neglect of this fact will explain that even such an expert of hypophyseal pathology as Cushing assigns in acromegaly to an increased basal metabolic rate a diagnostic significance superior to clinical symptoms. In some cases of acromegaly the rate is found high, but one must not forget that acromegaly, as a rule, is associated with an enlargement of the thyroid, and in my own experience not rarely is found accompanied by the symptoms of hyperthyroidism, including exophthalmus. Would it not seem more reasonable to account for the increased metabolism rather on the basis of hyperactivity of the thyroid than of the anterior lobe of the pituitary, since just this part does not influence metabolism to any degree?

I might cite in this connection the following observation: A woman, aged thirty-one years, claimed that she was taken sick ten years ago with cessation of menses, enlargement of the thyroid, suffering the typical initial facial pain of acromegaly. During the next year acromegaly had fully developed and was diagnosed. Three years later another physician advised a strumectomy. The operation was followed by reappearance of menstruation and improvement of her general nutrition without any beneficial influence on her acromegaly. Five years after operation we found a typical acromegaly with enlargement of the sella turcica. Basal

metabolism was normal, there was no adiposity, no genital dystrophy, menstruation was regular. Having no signs of increased intracranial pressure I could not advise operation.

Our own animal experiments fail to show any influence of anterior lobe extracts on basal metabolism, while extracts of the pars intermedia and posterior (usually called pituitrin) would tend to increase metabolism under certain conditions. Considering in special the clinical observation of specific distribution of fat tissue within the body and on its surface, we started with investigations to determine whether the hypophysis or other endocrines have an influence on mobilization and distribution of fat. We think that we might obtain some suggestions as regards an effective organotherapy of adiposity, which today is based entirely on empiricism.

Summarizing the influence of thyroid and hypophysis on metabolism we recognize many similarities and relations in the actions of both, realizing at the same time some differences, which will have to be explained by further studies.

We have mentioned on several occasions the pathologic physiology of both glands. Turning our attention now to their special pathology only a few important problems can be here considered. Anatomic findings still are fundamental in our discussion. Though only studied for a comparatively short time by pathologists, pituitary changes already have been revealed which might explain pathogenesis of symptoms and permit differentiation between distinct disease types. This is chiefly due to the fact that we have been in possession of sufficient data concerning the normal pituitary and its changes in size, weight and structure under different conditions of life. Even without precise knowledge concerning the direct relation between histologic picture and functional phase, we are justified in assuming hyperfunction in the face of an increase in size and weight of the organ, of a cellular hyperplasia and from the new-formed cell types in a tumor. The general term "adenoma of the hypophysis" I consider unfortunate because it really precludes a more precise conception of disturbed function of the various parts of the gland.

Less uniform we find the anatomic picture of hypofunction. This fact, together with the usual disregard of the various segments constituting the pituitary, explains why the commonly employed term "hypopituitarism" really is not definite and indeed often misleading. In cases of deficient development of the pars anterior (recognizable in the *x*-ray picture by the small sella turcica), furthermore in cases of secondary atrophy or actual destruction of this lobe, it is justified to assume a hypofunction leading to hypophyseal dwarfism, hypophyseal ateliosis and hypophyseal cachexia. Degenerative changes in anterior lobe tumors such as in adenocarcinomata are of a still undetermined significance in the pathogenesis. The theory of Tamburini that acromegaly has two phases, one of progression followed by one of retrogression, cachexia and death, cannot be accepted in view of the fact that in too many cases the first phase seems stationary for many years and does not lead to cachexia. One also can hardly agree with the idea of Cushing that acromegaly and adiposogenital dystrophy stand in a close connection, in so far as the primary hyperpituitarism of acromegaly is followed by a secondary hypopituitarism with the Froehlich syndrome. Primary adiposogenital dystrophy without any acromegalic symptoms is too common. In many of the cases of the Froehlich disease no sign of hypophyseal tumor can be discovered, though the symptoms of increased intracranial pressure might be present, but not necessarily so. The coincidence of acromegaly and dystrophy is a relatively rare occurrence. For its occasional observation we may better account by assuming an interfered function of the pars intermedia through the pressure of the enlarging anterior lobe tumor.

More important it will be to ascertain whether in cases of the Froehlich syndrome there are destructive processes present in the brain tissue, and if so, in which part; whether these cell groups which represent in man the pars intermedia are affected and to what extent; finally, what the condition of the connection between hypophysis and brain, represented by the infundibulum and hypophyseal stalk, actually is.

Recently we published from our clinic *x*-ray findings in cases

of adiposogenital dystrophy demonstrating alterations in size and position of the processus clinoidei posteriores. At the same time we described a method of recognizing in autopsy the patency of the channel connecting brain and hypophysis. I do not feel that our present information concerning the pathology of the pituitary gives us a right to speak of dyspituitarism.

Just as for every other part of the endocrine system it is also essential for the pituitary never to forget its close interrelation to the other endocrines, to the nervous system and to all organs and tissues of the body. The pathologic process, which affects the pituitary or one of its component parts, actually occurs within an organism whose constitution will markedly influence and modify the manifestations of the existing disease. What is termed dysfunction or dyspituitarism actually is only the result of a reaction in various parts of the body, modified by the individual's particular constitution.

To analogous results we come in a consideration of the pathology of the thyroid. While many questions have been elucidated by years of investigation and observation, the main problem of goiter seems more confused than ever. In American literature of the last decade with increasing preciseness a line is drawn between toxic and exophthalmic goiter. I knew these efforts from my reading, but could not harmonize them with my own experience. I think most of the Europeans had the same difficulty. We thought we understood the goiter problem, but now we have to realize that none of us has attempted to make this distinction, and the description of a toxic adenoma of American writers is not existing in our own literature. It might be advantageous to recapitulate briefly here the differentiation of goiter types as made by us.

Anatomically we differentiate the simple diffuse struma which includes the physiologic enlargements of the thyroid due to age and the sexual cycle and also the larger thyroids which in regard to size and geographic distribution must be considered as pathologic. This simple goiter might be a vascular, a diffuse parenchymatous or a nodular, slightly colloidal struma.

About fifteen years ago Aschoff described the simple nodular

adenoma of the thyroid commonly observed in the inhabitants of the plains and contrasted its occurrence and morphologic structure to that of the normal thyroids and goiters seen in typical goiter districts. Actually this nodular adenoma does occur relatively often just in regions where the true large goiter, the colloidal struma, is the rarest. It is this latter type which usually is called the surgical struma. Anatomically, however, they do not represent an entity. They show striking variations in size and consistency. Also the histologic differences are marked. In general, follicles, filled and distended by colloid, predominate. They often contain smaller and larger colloid cysts. The normal thyroid tissue in general reduced in part through compression, in part as the result of degeneration. But here and there are seen parts with a normal structure and even with signs of proliferation. This description applies to the sporadic and incipient endemic cases. The advanced endemic goiters of the mountaineers represent the first stage of endemic cretinistic degeneration and show predominatingly degenerative changes in the parenchyma and bloodvessels.

A second group of strumas form the parenchymatous hyperplastic thyroids. They are characterized by their relatively small size, by the peculiar softness of the entire gland and by the rich vascularization. Histologically they show numerous small follicles with little colloid, lined with a high epithelium, irregularly shaped follicles with a proliferating epithelium, and an abundance of interfollicular tissue. Strumas of this group can be differentiated from the Aschoff type of adenoma by the fact that in the latter there always are signs of retrogression in the centers of the nodules, while the diffuse hyperplastic struma may contain some normal looking areas but never centrally degenerated or atrophic nodules. Another important difference is in the status of the lymphatic tissue of the parenchymatous strumas. The normal thyroid contains strands and small nodules of lymphatic tissue in the interstitial stroma. This is invariably increased in the process of diffuse thyroid hyperplasia. The most characteristic feature of our Basedow struma is an enormous proliferation of this lymphatic tissue

and the occurrence of many very large lymph nodules in the thyroid and the surrounding tissues, a fact first emphasized by W. G. McCallum, of Baltimore.

The clinical differentiation of strumas is based upon anatomic differences, but certain groups also can be well defined by their characteristic symptomatology. Best known is the so-called surgical struma calling for operation on account of respiratory and circulatory disturbances caused by its excessive size or by an unfavorable, substernal location. They never exhibit any signs of disturbed endocrine function. These are the strumas of goiter districts in the first generation. Subsequent generations will manifest the result of degeneration in the form of deficient thyroid function, and thus we have the typical picture of endemic cretinism. For this type iodine has been used ever since the middle of the eighteenth century, accomplishing actual reduction of the struma.

The two other types, the small thyroid enlargement of puberty and the nodular adenoma of the people of the plains, have but little clinical importance. Medical advice, as a rule, is only sought for cosmetic reasons. Operative reduction in size or enucleation of individual nodules is occasionally practised by our surgeons. Decidedly more often iodine is employed externally and internally, unfortunately causing in some cases severe symptoms such as emaciation, nervousness, cardiac palpitation, etc. A symptom-complex thus would appear very similar to that established first by Basedow. The fact that they do not show all the characteristics of a fully developed Basedow led to the terms forme fruste, Basedowoid, and more recently they are described as various degrees of thyreosis. Kocher called this condition, resulting from iodine medication, struma Basedowii fecata to differentiate it from the true stroma Basedowiana. Soon, however, it was realized that such a Basedowification of harmless goiters would also occur, without iodine, in the course of physiologic changes in the patient, brought on by pregnancy, lactation or psychic excitement, and even without a recognizable cause. In this particular type one would seem to recognize most likely the toxic goiter of the American

writers. A noteworthy, possibly even essential, difference, however, seems to exist. We also see the occasional development of toxic symptoms in the adenomas of the peoples of the plains, artificially or spontaneously induced, especially in younger people. More often, however, we find this manifestation of toxicity in patients with diffuse hyperplasia strumas. In my own experience I do not know of any instance in which an adenoma, symptomless for years and even decades, had suddenly become toxic, as is claimed as a typical happening in this country. As far as I know our literature this occurrence is never mentioned. I also am not aware of the fact that any of our surgeons methodically enucleates these adenomata and is claiming prompt curative effects. We limit ourselves to the operative reduction of the enlarged thyroid in cases of true Basedow and of higher degrees of thyreosis. In lower degrees some of the typical Basedow symptoms are absent or hardly distinguishable. We lay more stress on the cardiac symptoms expressing the different degrees of thyreosis. The eye symptoms might stay in the background, but I decline to accept the importance of the absence of eye symptoms as a positive differential characteristic of a simple toxic goiter. Of the many so-called toxic goiters demonstrated to me in this country, but very few failed to reveal some eye symptoms if carefully examined.

The only one difference between true Basedow and the various grades of thyreosis, which I have recognized for a long time, is a striking and easily recognizable difference in the whole bodily constitution, which can be demonstrated without fail by a careful examination. True Basedow disease is seen only in individuals who show a constitutional anomaly which from a different point of view is variously called status thymicolymphaticus, status asthenicus or status hypoplasticus. In general they are tall, slender, pale and thin individuals, with abundant thin hair on the head, deficient in hair on the rest of the body, though lanugo may be present. They have not fully developed secondary sex characteristics, thin, transparent, and well-vascularized skin and nails. Their skin changes quickly its color. The subcutaneous fat may be abundant but always is soft. The muscles are poorly developed

and flabby, the long bones are strikingly elongated and delicate. Careful examination shows an increase in lymphatic tissue everywhere, and an enlarged thymus in the *x*-ray picture. The heart is small and has the droplet shape, the vessels are hypoplastic and narrow, the stomach is sagging and hangs perpendicular. There are disturbances of motility and secretion in the gastrointestinal tract. The gonads are hypoplastic and a general overexcitability of the nervous system is noticed. Without going into further details I wish to emphasize the blood picture, a predominant lymphocytosis and mononucleosis. This blood picture, pronounced as characteristic for Basedow by Kocher, really expresses only the constitutional anomaly.

I ascertained the presence of all these bodily features, just described, in every case of exophthalmic goiter I have seen in this country.

Cases of thyreosis, studied from this point of view, readily show the evident differences in bodily features of this sort from the true Basedow. There are no asthenics, no hypoplastics, there are no deviations from the normal type in their habitus or functional activities. They only show more or less distinctly symptoms of their disease, while in the Basedow patients the same symptoms are exaggerated by the coincident constitutional anomalies. Of course, we admit that no sharp line can be drawn between a perfectly normal and an abnormal constitution, and therefore even in the thyreosis some of the manifestations of a constitutional anomaly might be present, while most of them will be found in the Basedow patient. This form of differentiation admits to a certain degree the existence of a difference between toxic and exophthalmic goiter, though in a decidedly different meaning.

You must have noticed that I have carefully and purposely avoided any reference to theoretic explanations. I am of the opinion that all types of goiter can be differentiated either anatomically or clinically without the necessity of resort to theory. The term thyreosis, of course, does not qualify the character of the secretory anomaly and only expresses the existing thyroid disease. However, abstract desire for a satisfactory explanation seems to

be stilled by the interpretation of morbid function, that Basedow is caused by a hyperfunction and myxedema by a hypofunction of the thyroid. The evident insufficiency of an assumed hyperfunction in the explanation of the complex picture of Basedow led to the hypothesis of dysfunction, a sort of cheap assumption that thyroid secretion is not only quantitatively increased but also qualitatively changed. The fact was overlooked that the word dysfunction explained everything, but for this very reason really nothing, as long as one could not state the nature of the secretory change. Nevertheless, this teaching has gained ground and a differentiation between hyperthyroidism and dysthyroidism represents not only the foundation but the crowning feature of this sharp limitation of toxic from exophthalmic goiter. I shall avoid on this occasion to express a critical opinion on this matter.

In Rochester the discovery of thyroxin has led to conclusions concerning normal thyroid function, hypo- and hyperfunction and dysfunction, which while admittedly ingenious cannot be regarded as proved and convincing. But these remarks are not meant as adverse criticism because alterations and adaptations of a theory to new developing facts really prove the theory to be good. However, at the present time their conclusions are not definite; they are changed with each new publication, and even the last paper of Kendall dealing with a resting and active form of thyroxin furnished no direct proof that in hyperthyroidism and exophthalmic goiter thyroid secretions of different type and quality are produced.

Kendall assumes that in Basedow the cells of the whole body functionate abnormally, and in this way stimulate the thyroid to secrete a qualitatively changed substance, thyroxin in an unfinished state. As far as I can see this acknowledges the principles of a primary constitutional anomaly, and the secondary secretory anomaly is of no importance as long as this abnormal secretory product cannot be demonstrated. The failure of producing experimentally a true Basedow by feeding of thyroid extracts and injection of thyroxin is advanced as a convincing argument against its hyperthyreotic origin.

We cannot, experimentally, produce a true Basedow because animals have not the coincident constitutional anomaly essential for its development.

In conclusion, I wish to say but a few words concerning therapy. More recently here in America the important difference in reaction toward large doses of iodine is emphasized in the differentiation of toxic and exophthalmic goiter. The toxic goiter becomes aggravated, the exophthalmic improves, if 15 or more drops of a 5 per cent Lugol solution are given daily. The overexcitability of the nervous system diminishes. The dangerous somatic and psychic symptoms disappear. The exaggerated metabolic rate is lowered. But a return to normal is never reached, and later on all the patients are advised to submit to operation. A complete cure is never obtained even by repeated iodine medication.

In Europe the iodine treatment was practised until the occasional observation of an iodine Basedow made physicians apprehensive. The aggravation of toxic goiters, as recorded in this country, are only a confirmation of earlier Eureopean experience. We are using iodine most carefully and in small doses only in these struma cases in which the clinical symptomatology does not indicate any possible danger from iodine. I personally have in the past two years in light Basedow cases employed minimum doses of iodine with satisfactory effects. The suggestion to treat Basedow with iodine first came, if I am not mistaken, from Neisser in Stettin. I do not know anything about the results claimed by him. The systematic Lugol treatment of Henry Plummer, as far as I was able to judge, represents an important advance in the therapy of Basedow without the necessity of agreeing with the theoretical considerations on which the therapy is based. I am glad to have seen this work, because in the light of old teachings I would have hesitated to apply this therapy to my own patients, as I now contemplate doing. For my convenience I assume that the iodine affects not the thyroid but rather the constitutional impairment, exactly in the same sense in which formerly iodine effect used to be explained.

My paper may have become unduly long, but it certainly was impossible to say all I had to say in a shorter time.

IS THE ART OF THE PRACTICE OF MEDICINE AND SURGERY KEEPING PACE WITH THE ADVANCES IN THE SCIENCE OF THE PROFESSION?[1]

By D. J. McCARTHY, M.D.

A LONGSHOREMAN, aged forty-seven years, having been hit in the head by the hook of a moving crane on one of the Delaware River Piers, was admitted unconscious to my service at the Philadelphia General Hospital. He presented the picture of a cerebral injury. The reflexes were all exaggerated. There was a Babinski reflex, a positive Kernig, unequal pupils, a low-grade neuroretinitis and some third nerve palsy on one side. The *x*-ray examination of the head showed a depressed fracture over the right temporal area; the examination of the cerebrospinal fluid gave negative results for tuberculosis or other abnormal changes, chemical or bacteriological.

The resident physician called the surgeon, who diagnosed a fracture with pressure, and said the man should be operated on immediately.

A long experience with tuberculosis of the central nervous system led me to the conclusion that inasmuch as the patient showed evidence of a pulmonary lesion in the right upper lobe, we were dealing here with a tubercular meningitis, notwithstanding the negative laboratory findings, and not with a fracture-hemorrhage case, as was indicated by the *x*-ray and laboratory studies. Inasmuch, however, as tubercular meningitis was an absolutely hopeless prognosis, and a fracture was hopeful as to the outcome, I consented to operation. The patient died. We found that there was no fracture, but a well-defined tubercular meningitis.

[1] Read April 2, 1924.

Recently a case of late epilepsy, in a man, past fifty years, was presented at the Friday Neurological Conference, at the Philadelphia General Hospital. The man presented some arterial changes and minor neurological findings. On account of a negative Wassermann reaction, he was considered to be a case of essential epilepsy in a man past the meridian of life.

This case paralleled a case in my own practice of an individual with advanced arterial disease, who developed convulsions and later an apoplectic hemiplegia. The examination showed irregular, unequal pupils, some optic atrophy, but the blood serum and cerebrospinal fluid were entirely negative for the various syphilitic tests. I happened to be familiar with the previous history of this man, and knew he had had a specific infection in the past, so instituted antisyphilitic treatment, which gave exceptionally good results, and today this patient, with the exception of the arterial changes, is for all ordinary purposes a well man and back to his business. Had I not known the previous specific history of this individual, I might have been led astray by the laboratory findings, although I think my experience with cases of this kind would have led me to at least a therapeutic test, and eventually to a correct diagnosis.

These cases are examples of a fair percentage of cases in my experience in a large hospital and private practice, where we must depend not so much on the advanced laboratory reports as on collated experience and common sense.

Some weeks ago I was asked to see, in consultation, a woman, aged fifty-six years. I had seen this patient four years ago and had had her under treatment for a nervous condition, which was largely a resolution of an hysterical complex, due to a recent marriage, which had transplanted her from the free life of a Western ranch to the rather ingrown social life of a small Pennsylvania town, with a more moronic attitude toward life and its problems than the usual place of its size. By dint of repression on the part of the woman, and also of the town, they finally became adjusted to each other. She had previously had a hysterectomy at thirty years of age for a fibroid condition.

On December 23, last, some two weeks before the death of her husband, she was taken suddenly ill with an acute bilateral parotitis. There was an epidemic of mumps in the town, and it was properly assumed that this was an attack of mumps. The temperature of 101° to 102° lasted several days. At this time she showed marked somnolence. From this she went into coma with loss of control of both bladder and rectum. Her pupils were unequal, the right wider than the left. There was no reaction to light. A double wrist-drop developed. The reflexes were all exaggerated. Babinski reflex was present on one side and loss of power of the lower extremities. Her speech was bulbar in type with dribbling of saliva. One week later there was a well-defined ptosis of the left eyelid, with involvement of the seventh nerve.

The study of the cerebrospinal fluid gave a negative Wassermann and colloidal gold curve, but a diplococcus was found in three repeated studies of the cerebrospinal fluid.

She came out of the comatose condition in about four weeks. For the last six weeks she has shown marked mental confusion, with motor and mental irritability, rising at times to maniacal episodes. She is now disoriented as to time and place and personality and exhibits a typical toxic confusional state. The motor weakness has disappeared, but she presents the irregularity of the pupils with complete failure to react to light; a slight residual ptosis of the right eye lid, marked excitability of reflexes and absence of the abdominal reflexes. The heart muscle is very faulty, with valvular insufficiency and she has also a dry tongue—evidences either of a toxic state or this combined with faulty cardiorenal function. I might add that recently she has had two attacks of diarrhea, each lasting two or three days, with some mucus and traces of blood. She, however, had given a history of similar attacks of colitis, some two or three years ago, when traveling in the Far East.

The family doctor, a hard-headed, straight thinking man, of fifty-five or sixty years, had called into consultation a neuropsychiatrist, who had made a diagnosis of multiple encephalitis, postinfectious, following the mumps, and stated that she was now

suffering from a mental sequel to this, to which was added a toxic confusional state, partly cardiorenal, partly gastrointestinal, etc.

At the conference following the examination of the patient, I stated that I was in full agreement with all the findings in the case; the diagnosis *in toto*, and the treatment pursued.

Another younger neurologist, who had had previous contact with this case, insisted at this conference that this was a case of carcinomatous metastasis following the old fibroid hysterectomy. While I had given the possibilities of diagnosis as lethargic encephalitis, multiple syphilitic encephalitis, multiple tubercular encephalitis and multiple carcinomatosis, these were casually mentioned to be considered and excluded, and as little stress as possible placed on them. At the conference with the family they were advisedly not even mentioned.

Afterward I said to this young man, who insisted on his opinion, that I thought he was wrong in his diagnosis, and that his attitude both at the consultation and afterward was captious; was not the way to practice medicine; was not the art of the practice of medicine.

Neither he nor the consultant, nor any other specialist, had the right, under the circumstances, either directly (as in this instance) or by inuendo, to disturb the complete confidence this family had in their physician, unless he had good reasons, very good reasons for doing so, and was quite sure he was right.

These physicians had made a complete and thorough examination of their case; their laboratory studies were as complete as was possible under the circumstances; they had reasoned straight from a complete and detailed history and a complete, careful examination, supported by laboratory studies, and they had the right to expect cordial support from the consultant—had, indeed, the right to make the most probable diagnosis rather than a diagnosis of some rare disease that might have come at one time or other under the experience of the specialist.

These cases are quoted as a foundation of thought on the subject assigned to me—not of my own choosing—as to whether the art of the practice of medicine is keeping pace with the science of

medicine; or, more correctly, with the theory of the practice of medicine, because there is so much of theory nowadays that is not true, or is only partially true.

The science of medicine concerns itself with the facts of treatment and physiology and pathology of the human machine in health and disease. It concerns itself not at all with the individual. Strictly speaking, it has little to do with the nuances of relationship of environment and brain capacity and nerve tone. It deals with neither race nor character nor with previous experiences. It translates to human beings, in mathematical terms, the experiments on the lower animals, and applies them to the negro, the South Sea Islander, the Chinese, the European, and the Irish on equal terms. Science is a study of facts, and the clear-cut separation of fact from theory—and these factors of race and personality are not facts but accumulations of impressions. To those who practice medicine, they have, however, more weight than facts in determining the value of therapeutic measures in the treatment of tuberculosis in the Jew and the Irish.

These considerations deal more strictly with the practice of medicine and not so much with the art of the practice of medicine. When we speak of an art we set before ourselves a standard of action and conduct and work. We add to the technic the personality of the artist. It is the difference between a good, true, accurate photograph and a portrait painted by a master artist. The pure technician in the practice of medicine, the ultrascientific doctor in the case quoted, may feel obligated to tell the family the details and possibilities of the case; but if he is making the practice of medicine a fine art, like any other artist, he will paint in a much broader way and accentuate and omit as the conditions warrant, in order to do a finished piece of work that tells the vital truth and shows at the same time the individuality of the study and of the operator. In this sense of the term the practice of medicine does not differ from any other art. It cannot be learned, except in a very crude way, from books or lectures. It needs also for the master artist great brain power; to lesser minds it can be taught, but only in one way. He must serve his apprenticeship

with at least one master of medicine; must patiently sit at his feet and follow in his shadow.

The human animal is the paranoid—one might say the only paranoid in the animal kingdom. Surely, the cow or the monkey does not think the world and the universe revolve around them and for their special benefit. No cow ever took herself as seriously as even the simplest and most modest of our patients.

The science of medicine rests not on any one of our discoveries; it is built on a foundation of 3000 years of work, and what little anyone adds to it is not of so much importance as he or we think; and, after all, if he did not discover it just then, someone else would, in all probability, work out the same problem when the time and the science were ripe for it.

And the man who discovers a new serum nowadays, and has his name and achievement heralded broadcast by press and radio, his achievement rests on the old foundation. Is any of this new work more epoch making than the treatment of sick-bed fever by Holmes—the rescue of therapeutics from rank empiricism, and placing it on a sure scientific foundation by Wood in his work on *digitalis,* or the application of the broad principles of biological adjustment by Mitchell that raised the doctor from a pill-thrower and a prescription-writer, and placed him as a priest in the temple, the giver of the biological law who *applies* physiological principles rather than drugs in the treatment of disease? All these men were masters not only of the science, but especially of the art of the practice of medicine.

And when we turn to surgery, we find the master of this art today as always more dependent on his experience, his skill, his personality and his diagnosis than on any one test or group of tests. To say that the big surgeon of today, the leader of his specialty, does not take advantage of every mechanical aid, every biological test would be reflecting on his intelligence; but the art of a Deaver or a Crile, or a Cushing is dependent on something more fundamental than diagnostic aids. The backwoods surgeon, or the six-weeks' surgeon, has all of these at his disposal, but to no avail. His laboratory reports do not make him a real surgeon,

notwithstanding that he may be a moderately clever operator. If he stands at the table as an assistant for five or ten years while he practices general medicine, and follows the surgeon from bed to bed in some hospital, he will at least have the elements that go into the fine art of the practice of surgery. Whether he adds to this by intensive study of the individual and his environment, and builds up about him in turn a school of young men, depends on his brain power; and no man is a real leader of his chosen field who has not created a school of thought and of practice among young men who carry on into the future the tradition and the practices of the guild. Two excellent examples of this we see in Philadelphia and elsewhere, in the schools created by Mitchell in nervous diseases and Flick in pulmonary diseases.

The elevation of the practice of medicine in the five-to-seven years' course has created a new type of physician. While he is, as a rule, a cultured gentleman, he has too often the point of view that everything that is worth knowing has been taught him in the medical school, and that he has the right to the top of the profession in the hospital and among other physicians because, forsooth, the older and more seasoned specimens dare to make their diagnoses in spite of and often without the advanced laboratory aids.

In my day the students who aspired to distinction thought it well worth while to sit at the feet of Mitchell and Sinkler and Burr, and then to spend a few years abroad with Mendel and Flechsig and Kraft Ebing in Germany; Charcot and Renaud and Janet in France; and Gowers, Allbutt and Broadbent, in England. To their frail mental framework, layer after layer of thought and contact gave to them something of distinction—some little of the authority—some of the air of mastery of such men of brains and purpose. In this way they kept from being pocket editions of any one man, or of mistaking the little mannerisms for the real character behind the manner in their teachers.

They learned, as one master of the art expressed it to me, that it does not make so much difference what disease the patient has as what patient the disease has—and that the therapeutics, therefore, lay not so much in the relation of drugs as in the personality

of the patient and the personality of the doctor. I would not go so far as did a successful practitioner, who stated that 80 per cent of the therapeutics lay in the personality of the doctor. In my humble judgment I would place it at 50 per cent, with 30 per cent to 40 per cent to physician and mental adjustment by hygienic measures, and 10 per cent to 20 per cent to drugs and chemotherapy. If this should prove to be true in the practice of medicine by and large, it shows how relatively little the much-vaunted advances in the science of medicine count in the eventual results, and how much the personality of the doctor and the confidence of the patient in him means. The success of the osteopath, the neuropath, the chiropractor, the Christian Scientist is, if needed, added evidence.

And then, I think we overestimate the advance in the science of medicine. The great World War, as I see it, certainly in nervous diseases, gave us very little. On one occasion an order was issued from headquarters that all cases of pneumonia were to be given at a specified time 1 fluid dram of the tincture of digitalis, etc., irrespective of size or age, or whether the boy had high blood-pressure or low blood-pressure, and quite irrespective of his type or temperament or previous experiences. And this was supposed to be consistent, was indeed the most advanced and scientific treatment of pneumonia.

In the line of the prevention of typhoid the success was unquestioned. As to scurvy and typhus and other diseases, we are as far afield as ever. In surgery, Dr. Keen, saw in this war the old methods rediscovered, the Carrel treatment excepted.

In syphilis and its treatment we have made unquestioned progress; in diabetes the new insulin as a curative agent remains *sub judice*. In that vast field of endocrine disorders the less said of progress the better scientific feeling we will have.

I presume we know more of kidney disease and function than Tyson and Pepper and Da Costa; and more of the heart than Stokes; and more of the lungs than Louis and Flick; and more of surgery than McDowell and Agnew; and more of the brain than Gowers and Mitchell. But I take it that we do not know so much

more that it would compensate for our selection of some brand-new ultrascientist to solve our individual problems of soul or body rather than one of those makers of medicine. They all built on a sure foundation of anatomy and physiology and pathology, and added to it experience and brains and personality and high ideals.

There is, of course, a certain artistic excellence in completeness. A work may be so well done—so completely done—as to be artistic. With modern methods there is more complete work being done all the time by those who give time and thought to it; which means a more complete history, taking into consideration the secondary consequences of previous diseases and environmental conditions, both mental and physical, and a more serious consideration of the social background of disease, and with this a detailed study not only of visceral disease, but of disorder of visceral function. This, of course, cannot be done except in a limited way, with the old equipment of a waiting-room and an office, and there must be close coöperation between the family doctor and the surgeon and the specialists.

I am opposed to the usual group system, because there is no one at the top; no master whose duty it is to know the patient as a whole, and accept full and complete responsibility for the diagnosis and the eventual treatment, and also to be the assurance that the specialist has done his work in a correct manner, and to have his mind and attention directed to the angle of action of the local disease in relation to all other work already done or in prospect.

The accumulation of a lot of reports of specialists and of laboratory reports is not a study of a case. They only become so when they are properly directed in the first place, and then carefully studied by one who is himself a diagnostician; one who knows the elements of the specialties; who knows the strength and weakness of the specialists; who is trained in laboratory work to know the weakness and value of laboratory reports; and who will take the time to review the whole and give some study to it, and then write out his opinion in bold type, which is in itself encouragement to straight thinking and intellectual honesty.

This method of practising medicine is not only keeping up with the advance of the laboratory, but in some respects is keeping even ahead of it, as has been demonstrated by various men here in Philadelphia; and it is possible, with even less expense to the patient than the more or less commercialized groups in the West. The Mayo group, as established in the West for instance, is, I think fundamentally wrong.

The above method represents in many ways the real art of the practice of medicine, when it is a part of a general practice more or less specialized and not merely a diagnostic and repair shop.

There are family doctors in our midst, and doctors paddling their own canoes far in forest streams who conform more or less completely to this advanced idea of practice.

The Freudian movement that taught us the value of a complete history, like a cubist picture, is a bit lop-sided, in that it assumes that the brain exists independently of the body; that it functions equally, purely or impurely, irrespective of whether it is supplied with a normal or deficient quantity of blood; whether it is activated by a blood supply poisoned by rum or renal toxins.

I am not at all discouraged with the status of the art of the practice of medicine. I think it is keeping, if anything, well in advance of the science. We have master minds all about us following in the footsteps of those I have mentioned—only too much importance has been given in the schools to the test-tube man and the microscopist—too much insistence on teaching to the student the value of laboratory methods—too little stress on the value of observation, and experience, and character—too little attention to that individuality that is stressed all through Nature—and too little teaching of the ideals that this College has fostered. All the leaders who look down on you from the walls of this room were clinicians and masters of the art of healing.

And the plague of war and pestilence which has disturbed our point of view in medicine, as in other things, and bids fair to give us a generation of medical flappers, will pass.

We have with us today Flick and Cohen, and Lloyd and Burr, and Sinkler and Fenton, and Deaver and Cushing, and Babinski

and Marie, and Freud and many others. But today is too hurly burly—the world is too Bolshevick, and the human animal too paranoid to sit at the feet of anybody and learn anything that is worth while. It is a part of the consuming laziness of the world that lets a laboratory test replace the hard work of detailed histories and more detailed examination and study of the personality of the individual.

DISCUSSION

Dr. John B. Deaver: If the subject of this evening's discussion had been, "Does the science of medicine destroy the art of presenting an attractive paper," Dr. McCarthy's inspiring paper would have given us a negative reply. It has, indeed, been a pleasure to listen to him, and it is a privilege for the College to be able to add his discussion to the many brilliant papers recorded in their annals.

This question of the art *versus* the science of medicine and surgery is particularly pertinent at this time, when it seems that the science bids fair to overshadow the art, not because the latter cannot keep pace with the former, but because, living in a mechanical age, we are prone to depend upon mechanical devices and to neglect the natural means at our disposal. May we not raise the question: Is machine power to overcome man power?

Our distinguished forefathers would marvel at the advances made in medicine, and especially in surgery, as compared with the status of these subjects in their days. However, we must and never will fail to realize that their position on the stage will never be equalled, and certainly not surpassed, by the present or future generations, when we consider their lack in the way of instruments of precision and accomplishments, which we of today have at our beck and call. I love to recall the great accomplishments of their art done by brains and hands alone. I love to recall their great diagnostic ability and their unsurpassed operative skill. Their art was that of Rembrandt and his contemporaries.

The essentials of medicine and surgery which are necessary to class them as arts are the products of the brain of the medical man and of the surgeon. We must admit the aptitudes are, to a great extent, inborn; but even so, the brain must be trained and schooled to the task. "Chance favors the prepared mind." Experience is the answer. Careful study of the case, the first stage of which is the eliciting of the history, of itself

an art, including a most painstaking physical examination, and then the correlation of the findings, constitute the art of medicine and surgery.

Let us, for the moment, agree that the laboratory *x*-ray examination, etc., is the science. *X*-ray examination is essential today if the case is to be thoroughly gone over, and yet it will not measure up as an equal to the methods at the hands of the doctor who has learned his art at the bedside. Blood counts, blood cultures, blood-pressure estimates, cardiographic and sphygmographic tracings, stool examinations and *x*-ray studies are assets of moment; but the more experienced the doctor the less of moment they are.

I am sorry to say it, but I believe more reliance is placed today upon the results of the instruments of precision than on the examination of the patient. How many doctors will venture a diagnosis in many cases without, for example, a picture, by which I mean an *x*-ray study; or without a stomach analysis, if the case is an upper abdominal one; or without a duodenal tubal drainage—all of which are far from always being reliable? Those of us who daily make many biopsies know this only too well. The diagnosis of chronic appendicitis is now being made by the *x*-ray. Is this not a travesty on the art of diagnosis? That upon which the roentgenologist depends in making the diagnosis is the presence of tenderness, more marked over the region of the appendix in manipulating the barium filled bowel. These we admit are palpable signs which, if considered with the history, usually lead to the diagnosis without the barium and the *x*-ray. And what about rigidity of the overlying muscles, the palpation of the enlarged appendix, the presence of pain or discomfort following violent exercise, intestinal flatulence and the epigastric discomfort present in so many cases? To me the routine taking of an *x*-ray for the purpose of making a diagnosis shows want of confidence on the part of the doctor who is not sure of himself. I know of no simpler diagnosis to make, in the majority of cases, than that of chronic appendicitis, yet I do confess that what is often labeled chronic, at the operating-table, proves to be a mild acute appendicitis. Those who doubt this statement will be privileged to examine the specimens in the Lankenau laboratory, where there are some 30,000, all of which have been sectioned and studied microscopically.

That which has the most to do with operative dexterity is a knowledge of surgical anatomy and the ability to use the hands dexterously. This makes for the art in the operation. Knowledge of surgical anatomy and living surgical pathology enables the operator to consume the shortest time in doing the operation, which is of great advantage to the patient, particularly with the very sick patient. It goes without saying that the more frequently the road is traveled the more familiar are its landmarks.

I may interject that one of the weakest links in the chain of medical education today is the anatomical link. For example, in some of our best medical schools the greater part of anatomy, including dissecting, is taught in the first year, with a sprinkling of surgical anatomy in the way of lectures only to the third-year class; therefore, when the student is graduated he knows little or no anatomy.

The art of percussion, auscultation and palpation is as essential to the working surgeon as to the medical man, but I fear it is becoming a lost art with many, owing to the misplaced confidence in the *x*-ray. Personally, I am not willing to relinquish these to the *x*-ray, nor am I willing to relinquish the findings of aspiration in questionable conditions of the chest in favor of the *x*-ray; nor yet to relinquish the physical findings in a suspected subdiaphragmatic collection in favor of the *x*-ray.

These are examples of art in surgery, and in my experience they are not acquired by the strictly scientific means of examination. If these methods are not acquired, it is not the fault of the art but of the practice of the examiner.

More reliance is placed today upon the count of the white cells in determining the presence of pus than upon palpation, an art which, if properly applied, will reveal an exquisite tenderness more significant of the presence of pus than is the scientific method of a white count.

Auscultation, an art, is one of our most important means of determining certain abdominal conditions, and is not only not surpassed, but not equalled by any scientific method. The injection of air into the peritoneal cavity for *x*-ray diagnosis, one of the present fads, is more dangerous than an incision. I refer to the different types of peritonitis and intestinal obstruction in the diagnosis of which auscultation and palpation play so important a rôle.

There is no necessity for the science of medicine and surgery to overshadow the art. Indeed, I must emphasize that the art and the science should not be so sharply contrasted. They are inseparable, and the danger of the one overshadowing the other, if it occurs, is not due to any fundamental cause, but will be due entirely to faulty methods of medical training. I would emphasize that, as science progresses, we need only apply it, and in its application it becomes an art. Indeed, I should like to reverse the question and ask whether the science is keeping pace with the art? As a surgeon, brought face to face with many surgical emergencies, I would have to answer the question in the negative. The science is not keeping pace with the art, for in the art of surgery do I not daily, indeed dozens of times daily, meet with situations which my art tells me are so and so, and for which science gives no elucidating explanation? No! Science is not up to art; there are so many hundreds of questions in

the art for which science has as yet evolved no answer. Need I point out that the art of medicine has had most profound influence upon the science. Was it not due to the clinical and artistic acumen of many practitioners that problems were laid at the doorstep of the scientist? I need refer only to the question of the function of the thyroid as an example, which early in our generation was considered to be almost a vestigial structure, until artists in the form of surgeons, by the keen observation and practice of their art, showed that the thyroid presented a problem for scientific examination.

It is a subtle thing, this art of surgery. It does not consist of manual dexterity alone, although it is the primary essential. It is made of a combination of factors. One of these, and perhaps the most intangible, is the mysterious emanation, we might call it, by which at the first contact there is at once established a spirit of confidence between physician and patient. And then it is a combination of experience, keen observation, logical deduction, gentleness of touch and finally knowledge, exact knowledge of anatomy and anatomical relations, together with the functional phenomena which keep the human mechanism going. To this I must add a knowledge of pathological physiology, which includes, to my mind, the knowledge of how normal functions are perverted by disease, how Nature attempts to overcome this disease, and how best the surgeon or the medical man can lend his assistance in this effort at the critical time. Of course, our ideas of function, and even some of our ideas of anatomy, especially microscopic anatomy, have been much enhanced by the results of scientific research and investigations. But gross anatomy is still the same. All the scientists in the world cannot change the position of the various organs and their relations to each other. But it takes years of painstaking study, and not merely a few terms in the medical school, to acquire that knowledge, so as to be able to apply it at a moment's notice. It is in this respect that the manual dexterity of the surgeon is translated into the art of surgery. The sculptor, no matter how dexterously he may apply his chisel, must have some knowledge of human anatomy in order to make his presentation artistic and not grotesque. So the surgeon, no matter how many x-ray studies have been made, no matter how carefully the laboratory reports have been consulted, unless he knows what veins and arteries he has to expect to encounter and what kind of tissue he expects to cut down upon, cannot expect successful results. A clean piece of surgery is as keen a source of joy to the initiated as the sculptor's art. But what the public sees and judges by is the result of the operation. A patient restored to physical health, with his functions progressing normally, is the criterion of the public for the surgeon's art.

It matters not if the art has not kept abreast with the science if the

accomplishments of the art are of more value than those of the sciences. Science cannot take the place of many of the means of diagnosis I have mentioned, therefore the art has not been lost and science has not gone ahead of art. The various laboratory methods and findings, aids to both medicine and surgery, are where science shines, yet some of these fail us. Art in medicine and surgery is exact; science is not.

And it matters not if the art is behind the science or if the science is behind the art, the main point is that they both proceed. They are, as I have said, inseparable, and who among us can draw the dividing line between the two? The accomplishments of art are equally valuable and oftentimes more so than those of the sciences. Science cannot take the place of the means of diagnosis which I have mentioned; therefore, art is not lost, and never can be, and science in this respect has not and never will forge ahead of art. Let us therefore close with this thought, that the science of medicine is the handmaiden of art, that the art of medicine is the inspiration of the scientist. It is the artist at the bedside who should bring his problems to the scientist for solution if the art cannot solve them, and it is the scientist who should work, not isolated in his own little corner, but in the world of experience and in communication with the artist, so that both artist and scientist may share their problems, may alike bend their energies toward solution, and may alike rejoice in the benefits which they confer upon humanity.

Dr. Thomas W. Salmon: What the last speaker said was rather disconcerting to some of us and I hoped psychiatry and the rest of medicine might have met on the altar of science if not at the bedside of our patients. If psychiatry is not a science, we are, nevertheless, trying hard to get observations in shape so others who are scientists can group them. As practitioners, if not as scientists, we can get some pleasure of being of service to science, and we also get the pleasure sometimes of helping our patients. It is comforting to remember that if the proportion of science is small the proportion of art must be correspondingly great. Certainly, the pleasures of the practise of psychiatry are no less than in the practise of other branches of medicine. Sometimes we bring a little glimmer of hope to people who are discouraged; we bring about more comfortable mental attitudes on the part of those who have wrong views, and sometimes turn childhood into channels safer than those in which it is headed. So, even if we are not scientists we feel that we are working for the same ends as those who are.

Dr. Charles W. Burr: I think that the foundation of our trouble is that we are calling science a thing that is not science at all. Science is

nothing more than classified fact—knowledge. Now we today, by that I mean the world at large, the world that is interested in medicine, is saying that a thing is scientific because it is boiled in a test-tube or looked at through the microscope or presented on a photographic x-ray plate. Now, gentlemen, that is not science; these things are only very trifling tools of science. The knowledge that Dr. Deaver had—more years ago than I care to remember, when I was a student and he taught anatomy —the knowledge that he had in anatomy, was just as much science as anything going on in the laboratory today: My quarrel is not with science at all, but putting up machinery as a God. Worshipping the microscope, the microscope slide, the test-tube, the x-ray plate, the stethoscope and all the other scopes with which we look into this or that part of the body. Gentlemen, these are only tools that men of science use, and if the man of science be really a man of science, his conclusions are scientific, and he gives them only the weight that they properly deserve.

It is largely the fault of us who are teachers of medicine. Let me give you an example: I remember, as a student of medicine, Dr. John Ashhurst removed a tumor from the thigh, and he said to us, "Gentlemen, this is a sarcoma," and when he took it out he described the form and shape of it, and then he made a slice down through it and showed the variation in its surface—part of it soft like velvet; part of it bristles, like a scrubbing brush; the variation in color. He spoke of the density, the weight and so on, and we went out of the clinic room with a very clear and definite idea of what a sarcoma looked like, and most of us, at any rate, were conceited enough to think that the next time we saw a sarcoma cut out we would recognize it and be able to make a diagnosis. Twenty years after that I went to a hospital and saw one of the most distinguished surgeons in America remove a tumor, also of the thigh, and as he took it out he threw it into a bucket, and turned to the students and said: "Gentlemen, the pathological laboratory will make a report."

Now, gentlemen, that man was not a man of science or a real artist. Had he been a man of science he would have been able to tell the students what that tumor looked like; he would have been able to give such a picture and demonstration that they would have known what this thing looked like the next time, instead of being dependent upon a man cutting sections and slides. That is one of the reasons why students are getting in their subconscious minds a conception of science that is not really scientific at all.

Now, there is another error we make in medical education. Whenever I go to Blockley and ask an interne, if a new patient has come in, and what is the matter with the patient, I am never told what is the diagnosis. I am told whether or not he presents the last described reflex, or the last

described type of aphasia, or the last curious sign between organic and so-called functional disease. Now, gentlemen, the reason of that is simple enough. Most of us who are teachers of medicine describe so often the rare things, the things that we are interested in, that we are too proud to get down to the simple facts and teach these students the alphabet of disease, and consequently they go out knowing only about these rarities. But my internes, and they are the best men in the country, and they come from all over the country, never say: "Dr. Burr, this man has had a stroke of apoplexy." They tell me if the patient has a Babinsky, but they do not tell me the simple things, that he has had a hemorrhage, an embolism or a thrombosis. It is too small for them and too small for their teachers, and these teachers taught them so far above their heads that they never learned the alphabet.

It is the fault of us who teach medicine, that the rising generation of young doctors are getting a false conception of medicine. Art is the practise of medicine. No man ever succeeded in medicine unless he was an artist, and the greater artist he is the more successful practitioner he is. As soon as the doctor goes to the bedside he has a reaction on that patient for good or evil. I remember an old man in my youthful days in medicine, who was a very learned and scientific man in a sense, but every time he went into a sick room there was a frigid atmosphere all around him, and the sick person lost heart and the family began to think of death, and I am very sure that that man's death-rate was 10 or 15 per cent higher than it would have been had he been a man like others whom we know who go in and immediately the sick room looks more cheerful, the sick person begins to smile and begins to feel, "Here is the man who knows how to cure me," and that man not only must be a great artist, but a great actor, and if he is a good actor his death-rate will be much less than the man who is a poor actor.

As to real science, it is the fundamental of medicine; you cannot have medicine unless it be an art. The further along we get in classifying facts and knowledge of facts the better will our practice of medicine be. It manifestly must be so. In my own special branch of psychiatry there seems to be no science of psychiatry, but when there is, then the art of psychiatry will increase and we shall be able to help many patients who today are never helped at all.

A REVIEW OF SOME OF THE RECENT WORK ON THE DIAGNOSIS, PREVENTION AND TREATMENT OF DIPHTHERIA.

The Mary Scott Newbold Lecture

LECTURE XIII[1]

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I HAVE, at the commencement of this survey, to thank you for the honor you have done me in extending the invitation to deliver the Mary Scott Newbold Lecture of the College of Physicians of Philadelphia. The subject chosen on this occasion is still one of very considerable interest from the standpoint both of the public health administrator and of the research worker. For the former there is still the uncompleted task of prevention and control, and for the latter the opportunity of resolving some of the fundamental questions which remain unsolved in connection with infection and resistance in the disease diphtheria.

We should pause for a few moments to briefly review some of the important contributions made to the knowledge of this subject, beginning with the work of Francis Home, an Edinburgh physician, who in 1765 published a small treatise entitled *An Enquiry into the Nature, Cause and Cure of Croup.* This embodied the result of his clinical study of 12 cases of what he believed to be a new or rare disease, which he designated "suffocatio stridula." Home accurately described the formation of the false membrane in the larynx and trachea in this disease, but he also, at the same

[1] Read April 15, 1924.

time, succeeded in propagating an error, namely, that angina maligna and croup were two distinct diseases. In brief, while making an important contribution, he also laid the foundation for diagnostic and statistical difficulties which have not been entirely overcome even yet. Samuel Bard, of New York, in 1771, published his work, *Cause, Nature and Treatment of Suffocative Angina.* This memoir embodies some very vivid descriptions of diphtheria. Bard observed 17 cases, among whom there were 7 deaths.

We now come to the first name in the honor roll of those who have made enduring and substantial contributions to the knowledge of diphtheria—I refer, of course, to Bretonneau. His observations were made on a large series of cases, in the garrison at Tours and elsewhere, in the years between 1818–1826. The disease was raging at that time, as it had not done, apparently, since the period 1583–1618, when it had caused great ravages in Spain, where it was known as "garotillo."

Bretonneau's clinical observations were supplemented by most careful and thorough anatomicopathological studies. His work, in which were included the first four memoirs, he presented to the Academy of Medicine (*Traité de la diphthérite. Des inflammations spéciales du tissu maqueux et en particulier, de la diphthérite on inflammation pelliculaire, connue sous le nom de croup, d'angine maligue, d'angine gangréneuse,* etc), was published in 1826, and it had the great merit of being not only a classic as a clinical study, but in it, also, epidemiological data of great importance were recorded. The fact that the gums were first attacked in many cases was attributed by Bretonneau to the use in common of drinking cups. The importance of transfer of infection by such means is now universally recognized. To Bretonneau goes the credit for its first recognition. Bretonneau observed: "I should not express my entire opinion if I did not add that I see in this membranous inflammation a specific phlegmasia. . . . As it is impossible to apply to a special inflammation, which is so well marked, any one of the improper names which have been given to each of its varieties, let it be permitted me to designate this phleg-

masia by the name of diphthérite, derived from, διφθέρα (pellis, exuvium, vestis coriacea)."

Bretonneau wrote: "To prove that croup is only the last degree of malignant angina, that malignant or gangrenous angina is not gangrenous, that there is no relation between sphacelus or supposed superficial mortification and the alterations which this disease leaves behind it, would be a difficult undertaking even for a physician whose opinion would have all the weight due to eminence attained by useful labors. Although in a very different position it remains for me to accomplish a more delicate task, for I have not only to demonstrate the nature and identity of these affections, but must also show that the ancients had recognized this identity, and that, moreover, they had traced the objects presented to them with great fidelity, and that, in a word, they had represented them as they might be seen without the help of pathological anatomy; so that the illusion of distance, which must necessarily have been found in their representations, has become for the moderns a source of material errors, and errors the more dangerous because they have been solemnly ratified by the assent of many justly celebrated men. But the truth has only to exhibit itself in order to surmount these obstacles. From the moment when chance presented it to me, I thought that before publishing my conclusions it was my duty to direct my attention again to the observation of facts, to review them, to examine them a second time and to consider them under all their aspects.

"Sixty bodies were opened during the course of the epidemic. Although the examination of certain viscera, which had not presented any sign of morbid alteration during life, was sometimes neglected, the state of the digestive canal and of the air passages was always studied with the most minute exactness. I endeavored to prosecute my researches on the bodies of those who had more particularly presented either the characteristic symptoms of croup or those of malignant angina, whether the progress of the disease had been left to take its course without any treatment or had been fruitlessly opposed by the most energetic and most opposite remedies.

"In a great number of subjects I was able to follow the decreasing modifications of the disease up to its perfect cure, which was obtained under the influence of special, general or local treatment. A hundred and thirty soldiers, and twenty individuals of all ages, presented the different gradations, acute or chronic, of scorbutic gangrene, confined to the mouth or extending to the pharynx, and not differing, in the latter case, from gangrenous angina."

Bretonneau rightly believed that angina maligna and croup were one and the same disease, and another manifestation of diphtheritic inflammation, namely, scorbutic gangrene of the gums, were all due to one and the same etiological agent. Bretonneau's clinical and pathological observations are still of extraordinary interest.

Following Bretonneau came his pupil Trousseau, who proposed that the name of the disease be changed from "diphthérite" to "diphthérie," to indicate that he believed that the disease was a general and not a local one. The local lesions he regarded as manifestations of a disease which was a general disorder. Bretonneau later accepted the suggestions of Trousseau and adopted the name diphthérie.

Trousseau, in an endeavor to ascertain the mode of transmission of the disease, conveyed infectious material, taken from an individual suffering from diphtheria, into his skin and tonsils. He describes this experiment as follows: "It is evident to me that contagion performs the principal part in the propagation of diphthérite . . . still, I wished to perform upon myself a direct experiment with the view of ascertaining the communicative action of the serous secretion which flows in such abundance from the cutaneous surfaces attached with diphthérite. I accordingly steeped a lancet in a false membrane which I had just extracted from a diphtheritic wound, and I made one puncture in my left arm and five or six on the tonsils and the velum palati. I found on my arm at the seat of the puncture that a vesicle was developed very similar to that of vaccination, but there was no result upon the mucous membrane. Experiments of a similar character would require to be repeated, but even if they should not be followed by

the development of diphthérite, it must not be concluded that the disease is not transmissible, but only that inoculation is not the mode of transmission. The same remark applies to rubeola and scarlatina, the contagious properties of which are denied by none as far as I am aware." The great merit of this observation lies in the reservation made as to the conclusions which should be drawn from the experiments.

It is certain that to these distinguished French physicians we owe much for their clear and comprehensive clinical pictures, for their altogether admirable pathological studies, as well as for the initiation of animal experimentation in their desire to ascertain the truth in regard to diphtheria. Bretonneau published further studies in 1855, and Trousseau also in that year published a masterly series of clinical lectures.

We now pass from the period of clinical and pathological observations to the era which was ushered in by the first successful attempts to cultivate, as Löeffler describes it, "diphtheria material on solid culture media." This was in 1880. Between 1840 and 1880, as a result of the increasing conviction of the truth of and the wider acceptance of the doctrine that living agents were the cause of contagious diseases, many tentative suggestions were put forward as to the nature of the etiological factor in diphtheria.

While Klebs first succeeded in cultivating bacteria taken from the lesions of patients suffering from diphtheria, and while he undoubtedly did grow on artificial media, among other things, C. diphtheriæ (which he described at the Congress at Wiesbaden in 1883), he had not completely succeeded in satisfying the recently formulated postulates of Koch. The latter had, by his fundamental observations on the utility of solid medium for the isolation of single species through the cultivation of colony cultures paved the way for Löeffler, who in 1884, by the use of a new culture medium (solidified blood serum containing nutrient broth) obtained in his first experiment a positive result. On the surface of this new medium there appeared yellowish-white colonies of bacteria, which in stained smears were identical in appearance with those he had observed in sections of diphtheritic pseudo-

membrane. These investigations were made on 25 cases of diphtheria, from 6 of which C. diphtheriæ were isolated in pure culture. Löeffler next proceeded, by animal inoculation, to establish that the species of bacteria he had isolated produced characteristic lesions in guinea-pigs and rabbits. The fact that the microorganisms injected into these animals were found only at the point of inoculation and not in the internal organs, suggested to Löeffler that the other lesions observed must have been the result of a poison produced locally but circulating in the blood. He adduced no evidence in favor of this hypothesis at this time, however. Indeed, he admitted that he had been unable to reproduce the characteristic diphtheritic paralysis in animals. Furthermore, cultures of this germ were obtained from the throat of a healthy child, and cultures were not obtained in every case of the disease. For these reasons the etiological relationship was not regarded as being finally proven by Löeffler himself.

Roux and Yersin, in 1888, by entirely new methods and independently of Löeffler, proceeded to demonstrate that in broth cultures diphtheria bacilli produced a very potent poison which could be freed from the bacilli by filtering seven-day-old broth cultures through porcelain filters. These observers were able to produce a poison in broth cultures of C. diphtheriæ which in germ-free filtrates produced paralysis in rabbits and pigeons on injection. They made many other fundamental observations on the nature of this poison. Their experiments, which proved that paralysis was a constant sequel of C. diphtheriæ infection in experimental animals, and that germ-free filtrates served as well as broth cultures of these microörganisms, established with certainty the etiological relationship of C. diphtheriæ to the disease. Löeffler, later, was also able to obtain a similar poison from cultures of C. diphtheriæ.

Bacteriological studies carried on in all parts of the world soon abundantly confirmed the work of Klebs and Löeffler and Roux and Yersin. Thus two great forward steps had been taken. Following these important investigations of Roux and Yersin, a number of workers made attempts to immunize animals against

diphtheria poison. Löeffler, in 1890, reported an interesting experiment in which a guinea-pig injected into the skin with diphtheria bacilli suffered a severe necrosis; after a brief period a second injection produced a local swelling; in addition, however, a severe paralysis. Subsequent injections into this animal produced only a slight degree of local reaction. This indicated that the animal had developed a considerable degree of resistance.

In 1890, Behring and his colleagues began a series of epoch-making contributions. These culminated in 1892 in his reporting to the Seventh International Congress of Hygiene and Demography in London that by experiments carried out with Wernicke he was "able to demonstrate that the resistance of guinea-pigs against the specific diphtheria poison is increased with their resistance against the living bacilli, and that the blood of highly immunized guinea-pigs possesses outside the body the power of destroying the diphtheria poison; and, further, that guinea-pigs can be rendered immune by intraperitoneal injections of the blood of immunized animals, or, if infected, can be cured." The fundamental discovery of diphtheria antitoxin was thus made and its production in large quantities was begun in various laboratories in many countries.

With the communication by Roux, in 1894, to the Eighth International Congress of Hygiene and Demography in Budapest of the remarkable results obtained in the treatment of diphtheria, in collaboration with L. Martin and Chaillou, supplemented by details of the methods of toxin production, immunization and obtaining serum, the climax of a period of extraordinary productivity was reached. This established serum therapy in diphtheria on a firm basis.

In the same year (1894) a most significant but infrequently emphasized contribution was made by Abel and Wassermann independently, when they observed that the blood of many healthy individuals who have not had diphtheria possesses the property of protecting guinea-pigs against fatal doses of diphtheria bacilli or toxin. They assumed that bacilli were therefore unable to harm such immune persons because the toxin has no effect upon

them. These very important findings may be the explanation of Trousseau's failure to infect himself, and they also shed a flood of light on two or three major points then in dispute in relation to infection and immunity in diphtheria. In the first place it served to explain fully the objection raised in connection with Löeffler's earlier work that C. diphtheriæ might not be the cause of the disease, since it was occasionally found in the throat of healthy persons who had no symptoms of diphtheria. This paradox was explained and a class of healthy carriers was shown to exist. This was distinctly pointed out by Wassermann in 1895.

In the second place all subsequent work on natural immunity to diphtheria in man was capable of explanation on this basis. such immune persons are insusceptible because they possess a certain amount of natural antitoxin. Just why they happen to have this natural antitoxin is another question which is only in the process of solution at the present time. Roux and Martin, in 1894, were the first to observe the presence of diphtheria antitoxin in normal horses. Cobbett (1895) and Bolton (1896) confirmed these observations. This interesting investigation of natural immunity to diphtheria in lower animals was very fundamental. It has since been demonstrated that natural or normal antitoxin is only found apparently in susceptible animals (man and horse?).

Following the work of Roux and Yersin, Ehrlich began the series of researches on the results of which present knowledge of the structure of diphtheria toxin largely rests. These investigations, carried on between 1894 and 1900, were of profound importance. Their significance is so often blurred in the haze of controversy that certain considerations of great practical importance may be forgotten. Ehrlich first applied in his study of toxins the methods of organic chemistry. Soon he realized that the extraordinary complexity of toxin rendered it necessary for him to adopt the biological method of attack. This resulted, in a very short time, in the introduction of certain exact quantitative conceptions which have been of great value. The so-called Lo, L+ and M. L. D. values were introduced and defined. While it is true that his desire to explain in terms of chemical combination the

various changes that take place in toxin as a result of aging or of the action of physical or chemical agents, or, from the admixture of toxin and antitoxin, in varying proportions, led him into what many observers believe were unnecessary complexities, still much of value was achieved. Following Ehrlich and his coworkers, Park and Williams, Arrhenius and Madsen, Salomonsen and Madsen, Madsen and Walbum, Dreyer and Madsen, Brieger and Boer, Morgenroth, Behring, Roux, Danysz, Bordet, Dean and more recently Glenny, Glenny and Südmersen, Ramon and other workers have made important contributions to this subject. In consequence three or four concrete hypotheses as to the mechanism of toxin-antitoxin action have been formulated. These need only receive mention here. The work of Römer (in 1909), of which more will be said later; the recent work of Ramon and finally the introduction of certain additional methods of measuring toxin action (such as the minimal skin-reacting dose, etc.) have perhaps been the most substantial advances made. We are still in ignorance of the exact chemical nature of diphtheria toxin, of the precise changes which it undergoes under various conditions and most important of all, how it produces its most deleterious effects.

The introduction of antitoxin in the treatment of diphtheria at once made evident that some method of determining the therapeutic value of various preparations of antitoxin was essential. Irregularity in results followed the procedure of Behring of injecting living organisms into one area and antitoxin into another of the same test animal. Ehrlich conceived the idea of mixing the toxin-antitoxin *in vitro* and subsequently injecting the mixture into guinea-pigs. This was the first step in advance. Various lots of antitoxin were tested, using an aged toxin as the constant factor. Ehrlich soon found that the toxin was not constant, and, indeed, that both toxin and antitoxin in liquid form were quite unstable.

He learned, further, that dried diphtheria antitoxin was more satisfactory as a standard than precipitated and dried toxin. In consequence he decided to prepare a dried preparation of antitoxin (which if light and air were excluded would remain constant) which could be used as a standard. He next proposed that the

death of the test animal should be the criterion in the determination of potency of antitoxins. His L+ value of toxin was set up as the amount of toxin to be used in the determination of antitoxic strength. So it came about that the unit proposed by Ehrlich is the amount of antitoxin which when mixed with an L+ dose of a suitable toxin leaves unneutralized in the mixture sufficient toxin to cause the death of the test animal within four days. The fact that combining as well as toxic elements are contained in the toxin was early recognized.

Without entering into a detailed analysis of the work of Ehrlich, Arrhenius and Madsen or of Bordet, bearing on this, or considering the merits of their respective explanations, it is necessary to recall that toxin modified by certain physical or chemical agents, as well as by the addition of antitoxin, may be made much less toxic while it remains quantitatively unchanged in respect of its combining power with antitoxin. Because of the very complicated and varied terminology used in the papers dealing with this subject, exact definition at this point is essential.

In 1901 Madsen and Dreyer, using mixtures of toxin-antitoxin, in which only "toxone" (in the Ehrlich meaning of the term) was free, succeeded in stimulating antitoxin production. In 1904 Glenny showed that toxin, which would not kill guinea-pigs of 250 grams' weight in 5-cc doses, would, nevertheless, stimulate antitoxin production. Finally, in 1909, Arkwright demonstrated that filtered broth cultures of two strains of C. diphtheriæ, which were morphologically and culturally indistinguishable from virulent Klebs-Löeffler bacilli, but which possessed no pathogenicity for guinea-pigs and apparently, were not toxigenic, led to the development of antitoxin when injected in large quantities into a horse.

It is necessary at this point to refer to the fact that the method of measuring the therapeutic power of diphtheria antitoxin employed by the French, as a result of the work of Roux and his collaborators, is essentially different from that of Ehrlich. It has been defined as follows: "The preventive strength is said to be 50,000 when 0.01 cc of the serum protects a guinea-pig of

500-gram weight against a dose of diphtheria toxin which kills a control animal of the same weight in thirty-six to forty hours. The relation between the weight of the animal, 500 and the quantity of the serum employed is the measure of the preventive strength of the serum. The serum is injected twelve hours before the toxin. Every guinea-pig which has not lost weight after six days is considered protected. The curative strength of a serum is estimated in a similar manner. In this case the toxin is injected six hours before the serum. The guinea-pigs surviving on the sixth day are considered cured. In place of the toxin the living bacilli may be employed for the tests."

Differences of opinion have continued, up to the present, as to the relative merits of the Ehrlich and Roux methods of standardization; the former, however, has been adopted practically everywhere except in France, as far as I am aware, and the Ehrlich unit has served as the basis of standard units since prepared in various other countries.

In connection with the question of standardization of antitoxin and the determination of unitage, it is important to remember that what is really ascertained is simply the toxin-neutralizing power of any antitoxin. Furthermore, it is a combined *in vitro* and *in vivo* determination, and the conditions which obtain in the human being under ordinary conditions of infection are naturally very different.

It is not an infrequent experience for those responsible for serum production to receive communications from physicians commenting on the fact that in certain cases of diphtheria a given dose of antitoxin has not had the effect which, from his clinical experience, the physician has anticipated it would have. Unfortunately, it is practically impossible, as a rule, in such instances to ascertain the exact facts at first hand or to undertake investigations, because the reports are received, as a rule, after the recovery or death of the patient. The significance of these observations in reference to the question of therapeutic efficacy of antidiphtheritic serum in its relation, in turn, to toxin neutralizing power is of great interest, however, and may have some practical importance. The conten-

tion of Roux that the measure of toxin neutralizing power determined by the present method of standardization of serum has certain inherent limitations seems to have been substantiated by the work of Cruveilhier in 1905 in Roux's laboratory. This investigator compared sera of different antitoxic strengths obtained both from different horses and from the same horse; as to their preventive and therapeutic action on guinea-pigs into which living cultures of several strains of C. diphtheriæ were injected subcutaneously.

It was found that more marked therapeutic effects were observed with a serum of lower antitoxic power than with one of higher antitoxic unitage in a majority of the experiments. He concluded, as a result of these investigations, that "the curative action of a serum does not depend exclusively upon its content of antitoxic unitage." Further, "that the titration of antitoxin as carried out at present does not suffice to render an exact measurement of the efficacy of a serum. This latter property is more exactly determined by what we have designated the measure of the therapeutic power." Further work is necessary to ascertain whether the conclusions of Cruveilhier can be substantiated, and if so, whether they furnish an explanation of such experiences as those just related.

In the splendid monograph on *Diphtheria* by Andrews, Bulloch, Dreyer and others, which has just (March, 1924) been published by the British Medical Research Council, the following opinion is expressed on this question:

"We have now to consider whether the antitoxin unit is really also a unit of curative power for human diphtheria, as is assumed in the system of measurement for antitoxic power. Experimental work led to the belief that sera containing from 200 to 500 units per cubic centimeter all had about the same protective and curative power for guinea-pigs. The clinical administration of sera of various antitoxic strength also gave the impression that the antitoxic power was not the only significant property of the sera. The diametrically opposed school of thought which believed that the healing power of antitoxic serum depends absolutely on anti-

toxic titer had equally strong suppporters." . . . "In view of what has been said, we do not consider it justifiable to depart from the orthodox view that a serum depends for its preventive and curative power primarily upon its antitoxic strength."

In addition to the *in vivo* methods of testing antitoxic properties in antidiphtheritic serum, certain *in vitro* methods of titration of diphtheria and other antitoxins have been proposed by Calmette and Massol (1909), Nicolle, Cesare and Desbains (1919), and especially Ramon (1922). These are all essentially flocculation methods, the criterion of toxin-antitoxin neutralization being the appearance of a precipitate at a certain point.

We may now proceed to a consideration of developments which have taken place in the laboratory investigations of C. diphtheriæ. The observations of Hofmann, published in 1888, emphasized the statement made in the previous year by Löeffler, that there existed a species of microörganisms very similar in morphology to true Klebs-Löeffler bacilli and only distinguishable from these latter by their inability to produce harmful effects when injected into guinea-pigs or other experimental animals. This species, since known as C. hofmanni, was obtained in the nose, throat and elsewhere, alone and in association with true diphtheria bacilli, in persons recovering from diphtheria as well as in healthy individuals. Löeffler emphasized the necessity of injecting cultures suspected of being C. diphtheriæ into guinea-pigs in order to differentiate them from closely related species. Confusion has resulted not only from a great mass of contradictory evidence in regard to C. hofmanni, but also as a result of the description of a species of diphtheria-like microörganisms found chiefly in the conjunctivæ of persons suffering from xerosis, which led Kuschbert and Neisser, who discovered it in 1884, to describe it as C. xerosis.

In the light of present knowledge it can very readily be seen that much unnecessary misunderstanding has arisen as a result of a very simple pitfall, namely, the almost universal disregard of the warning issued by Löeffler in 1887 and the attempts made everywhere, by various methods, to distinguish C. diphtheriæ on the basis of morphology alone or of morphology and staining.

It is only natural that such attempts should be made. The introduction of bacteriological methods of examination of material from cases of diphtheria, from suspects, contacts, etc., very soon resulted in a great expansion in laboratory work which in many instances must have been done with slender resources and under conditions which taxed to the utmost the ingenuity and fortitude of those responsible for its conduct.

The work of the American pioneers in the bacteriology of diphtheria is worthy of the greatest respect and admiration. A number of them have long been distinguished members of the profession in this country. Included are Park (and his colleagues), Welch, Flexner, Theobald Smith, Abbott, Councilman, Mallory, Pearce, Bissell, Stokes, Bolton, Pease, Hill, Denny and the late Hermann Biggs, Wyatt Johnston and F. F. Wesbrook. Wesbrook and his colleagues, Wilson, McDaniel and Adair, at the University of Minnesota in 1900, published a morphological study of C. diphtheriæ and closely related species which not only was much more complete and comprehensive than any previous investigation of this phase of the question, but still serves as a guide for beginners and experienced workers alike. As a preliminary to the study of strains of C. diphtheriæ, complete and definite knowledge of morphology is essential, and for this purpose the classification proposed by Wesbrook, Wilson and McDaniel is of the very greatest service. No work on this aspect of the subject since 1900 has supplemented to any considerable extent our knowledge of morphology.

At the outset of his work, Löeffler recognized the need of a special staining method for these microörganisms and introduced his well-known alkaline methylene-blue stain. Roux, in 1890, suggested a method by which metachromatic granules could be demonstrated.

In 1897 Neisser described his differential staining method, which, while it has a certain value, was one of the reasons why an immense amount of time was spent upon the investigation of morphology. His further claim to be able by this method to differentiate true diphtheria bacilli from diphtheroids was the reverse of helpful. It is probable, as Force has recently pointed out, that this claim of

Neisser's was the reason that for many years Löeffler's advice was disregarded and the morphology of unknown cultures, rather than their toxigenic capacity ("virulence"), was the characteristic most frequently studied. This tendency was perhaps further exaggerated as a result of the investigation which showed that considerable variations in toxigenic power existed among different strains of C. diphtheriæ. Finally, it was often impossible, by the uncertain methods then employed, for workers in laboratories where routine bacteriological examinations were made, to carry out satisfactorily the necessary tests of toxigenic capacity. It must be emphasized that what was desired was a knowledge of the toxin-producing power (or toxigenic capacity) of the culture and not its invasive power or virulence in the true sense. Hence, the administrative control of diphtheria which is based on a bacteriological examination of material from persons believed to be harboring the causative agent, really resolved itself into a question simply of morphological identification. It is true that in a few laboratories, and under the best conditions, so-called "virulence" tests were carried out.

Recent advances in laboratory diagnostic procedures for the recognition of C. diphtheriæ have been twofold. First, there has been a careful reëxamination of morphology, tinctorial reactions, cultural features and biochemical activities on the one hand, and, on the other, a study of immunological reactions and toxigenic capacity.

Biochemical reactions have largely been concerned with a discussion of fermentative activities in carbohydrate media, and on this question most contradictory evidence on certain points has been published. It has assumed more than academic interest at times, because proposals have been made, and, within the past ten years, that final recognition of C. diphtheriæ might be made on the basis of its activity in carbohydrate media. This is probably not a safe procedure because of the contradictory results obtained in the study of saccharose utilization. It is believed that findings which will be in agreement can be obtained by different workers if two conditions are satisfied, namely: (1) purity of

cultures (recent work of Eagleton and Baxter and FitzGerald and Doyle has emphasized the importance of this factor) and (2) sufficient buffering of the medium. Enlow's medium, which has just recently (1923) been described, serves this purpose satisfactorily.

Assuming, then, pure cultures and sufficient buffer action, C. diphtheriæ should produce acid in glucose and dextrin, but not in saccharose or mannite.

The other aspect of the laboratory investigation of this species is of very great interest and practical importance. It has long been known that in addition to producing a specific toxin, injection into animals of emulsions of diphtheria bacilli results in the production of agglutinins, fixation-antibodies and other immune substances. Nicholas, Lubowski, Lipstein, Schick and Ersittig, Gordon, and more recently, Durand, Mason, Havens, Bell, Christiansen, Park, Williams and Mann, Paxson and Redowitz, Hartley, Scott, Eagleton and Baxter, FitzGerald and Doyle and others have explored various aspects of this subject. The one phase of the question which is pertinent at the moment is, simply, "Is the agglutination reaction of any assistance in the indentification of C. diphtheriae?" There are no differences of opinion in regard to certain points. It has been definitely proven that diphtheria bacilli are readily agglutinable, that their agglutination is highly specific and that by means of the agglutination reaction alone or combined with absorption of agglutinin it is always possible to differentiate diphtheria bacilli from diphtheroids. It is true that there exist a very considerable number of agglutinative types or groups. The exact number of these is uncertain; there are at least three or four, and there may be ten or more. The work of Durand, begun in 1918, led a number of investigators to reëxamine the question, with the result that much information has been obtained during the past three or four years.

Havens in a communication in 1920 claimed that he had obtained evidence which seemed to indicate that two different agglutinative types of C. diphtheriæ studied by him produced qualitatively different toxins. This has not been confirmed by subsequent work, and it is highly probable that *no qualitative* differences exist between

the types of toxin produced by the various agglutinative types of this species, even though there may be very considerable *quantitative* differences in toxigenic capacity and possibly variation in the rate of toxin production by different strains.

Certain technical difficulties in the preparation of diphtheria agglutinating sera have been experienced by many workers who have interested themselves in this question. In consequence, and also because of the existence, of several agglutinative types within the species the utility of the agglutination reaction has been in question. The following facts, recently elicited, have an important bearing on this matter. Scott has shown (1923) that non-toxigenic but otherwise typical strains belong (on serological grounds) to C. diphtheriæ. Of 40 non-toxigenic strains, 13 were identified serologically with groups containing virulent (*i. e.*, toxigenic) bacilli. These 13 strains (among 265 investigated) were true diphtheria bacilli, identified by means of agglutination, because they were, at least when investigated, non-toxigenic. This is exceedingly interesting, taken in conjunction with another observation of this same worker. One strain which was under observation for a period of more than eighteen months lost and regained its toxigenic power. Miss Doyle and I have encountered a strain in our series of cultures which originally was actively toxigenic and agglutinable. It has since almost ceased to produce toxin, but continues agglutinable. Scott isolated 5 per cent of non-toxigenic strains from acute cases of diphtheria and 2 per cent from convalescents. We have studied a number of strains which when tested were non-toxigenic but agglutinable, and were from persons with undoubted diphtheritic infection. These investigations had been made with pure, single colony cultures. It is impossible to declare with certainty that there was no admixture of types in the colonies studied, but with that reservation it is reasonable to infer that cultures of C. diphtheriæ may sometimes be identified by means of the agglutination reaction when toxigenic tests are negative. In other words, agglutination tests with polyvalent sera (or monovalent if necessary) may sometimes be of value in supplying supplementary information not obtainable by

means of the toxigenic ("virulence") test in the study of certain strains.

Scott propounds the further question: "Could an agglutination test be employed instead of an animal test in the determination of virulence?" (toxigenic capacity). As a result of his study his answer to the question is: "In view of the fact that only two of the group sera included both virulent and non-virulent strains, it would appear that a positive result (absorption of agglutinin or high-titer agglutination with a specific serum) with one of the first six group sera might safely be regarded as equivalent to a positive 'virulence' (toxigenic capacity) test."

Independently, Miss Doyle and I have been investigating the same subject. In a preliminary note published before Scott's monograph appeared, using whole-field cultures from cases of diphtheria, we obtained by means of the agglutination reaction, results which were in harmony with the findings in smear examinations, in from 75 to 90 per cent of cases. In a number of instances when no characteristic bacilli were seen in smears, positive agglutination tests were obtained, and in every such instance the history obtained indicated that the patient might have been suffering from mild diphtheria. Two monovalent rabbit sera were employed in these tests. Spontaneous agglutination was occasionally encountered. Utilizing an agglutinating serum, prepared by the injection into a horse of several types of C. diphtheriæ, parallel investigation of morphology, "virulence" (toxigenic capacity), and agglutination was undertaken in a series of 105 mixed-field cultures from patients with diphtheria. Ninety-two gave a positive "virulence" (toxigenic) reaction and 82 a positive agglutination. In another series about 80 per cent gave a positive toxigenic and about 55 per cent positive agglutination. These investigations are being continued to ascertain whether a broadly polyvalent agglutinating serum will give, with whole-field cultures or pure cultures, results which will obviate the necessity for a toxigenic ("virulence") test or will supplement the information gained by the use of the latter.

The determination of power to produce toxin as originally pro-

posed by Löeffler involved the use of one or more test animals for every culture investigated. The injection of the culture itself, or a stated amount of the filtrate (in which the strain of micro-organism had been grown) into one guinea-pig, and the same material, with the addition of diphtheria antitoxin, into another guinea-pig (as a control) was necessary. For each toxigenic and protection test two animals were used. This was expensive and not always satisfactory. In 1909 Römer made the important observation that the intracutaneous injection of a small amount of diphtheria toxin into a guinea-pig produced a characteristic lesion in the skin. Very small quantities of toxin produced a slight edematous swelling and redness which persisted for three or four days, and is followed by a falling of the hair over the inoculated area. With the injection of slightly larger doses of toxin a little necrotic area (following redness and infiltration at the site of inoculation) is observed. This very important contribution has had great significance not only in relation to the determination of the capacity of cultures to produce toxin, but also serves as the basis of methods (including the Schick test) for the detection of small amounts of antitoxin and the standardization of toxin-antitoxin. Novotny and Schick, in 1910, observed the effects of percutaneous applications of toxin diphtheria, as Pirquet had done with tuberculin. Neisser, a little later (1913), employed emulsions of living cultures of C. diphtheriæ for intracutaneous testing and found that the results obtained were similar to those obtained by subcutaneous injection. In 1915 Zingher and Soletsky modified the procedure of Neisser and recommended the use of two guinea-pigs: One a control animal, into which antitoxin had been injected (which animal could be used a second time within a week without further administration of antitoxin), and the other the test animal. Into both intracutaneous injections of emulsions of four different cultures were made. By this method four cultures could be tested in 2 animals instead of 8, as in the older method. Smeeton, in 1917, compared the intracutaneous and subcutaneous methods for the detection of toxigenic power, and concluded that the former was more accurate and also was a saving in time and expense. Eagleton

and Baxter, in 1921, still further modified the Neisser method by recommending that standard suspensions of emulsions of the cultures be injected and known positive and negative control cultures included. They also proposed that in addition to injecting 500 units of antitoxin into the control animal the test animal be given 125 units of antitoxin four or five hours after the intracutaneous injection of the culture suspensions. The use of this so-called "following" dose, suggested by Eagleton and Baxter, saved the life of the animal if several active toxigenic strains were injected, but did not interfere with the local reaction in the skin.

All the methods so far described required the isolation in pure culture of C. diphtheriæ from the original whole-field culture. Frequently the isolation in pure culture of the strain to be tested from the field culture is difficult or impossible. The admixture of many colonies of diphtheroids with relatively few colonies of C. diphtheriæ may mean that colonies of the latter are not picked and a false negative result is obtained.

Based on some preliminary work of Wayson in 1916 (in which he suggested the injection subcutaneously of whole-field cultures and also made a few observations on the results of the intracutaneous injection of the same emulsions), Force and Beattie and Havens and Powell in 1922 described methods of testing whole-field cultures by intracutaneous injection. The work of Force and Beattie is quite comprehensive and all the methods previously proposed are considered in detail, and the technic and merits of the method proposed by them set forth. The results of the investigations of these workers has recently been substantially confirmed by Bull and McKee. It occasionally happens that virulent streptococci when present in field cultures with C. diphtheriæ may cause the death of both control and test animals. In this event, or if for any other reason, the results are unsatisfactory when whole-field cultures are used, the isolation in pure culture of the organism and its subsequent testing intracutaneously is necessary.

Within the past month, Fraser and Wigham (March, 1924) have recommended the use of rabbits for the intracutaneous test of whole or pure cultures of C. diphtheriæ as well as for the testing

of minute amounts of toxin-antitoxin. This method makes it possible to test a large number of cultures—twenty-four or more—on the same animal, under comparable conditions. Using known negative and positive controls and a following dose of antitoxin, this is perhaps the most satisfactory method so far suggested for testing a large number of cultures, or toxin-antitoxin mixtures, at one time.

It would appear, then, that if a strain of C. diphtheriæ is toxigenic when tested, its identification can usually be established with certainty. However, concrete difficulties still present themselves when resort is had only to toxigenic tests. Bull and Havens have just reported (November, 1923) the results of the investigation of 7790 combined nose and throat cultures obtained from school children in Baltimore. Among this large number 338 cultures were considered positive on morphological grounds. Among these 338 positive cultures, 136 were found, by means of the whole-field culture test, to contain toxigenic diphtheria bacilli.

These observers point out, however, that "diagnostic films of 102 cultures which proved to be avirulent contained typical granular forms. Pure strains isolated from 55 of these avirulent cultures had typical morphology and gave typical carbohydrate reactions. These cultures were apparently devoid of virulence, since massive doses failed to cause characteristic lesions in guinea-pigs." It would appear that these results lend support to the thesis that identification of strains of C. diphtheriæ which are only weakly (if at all) toxigenic when tested should be attempted by means of specific serum agglutination.

The serum treatment of diphtheria introduced by Behring (1890), and first shown to be of extraordinary importance by Roux and Martin in 1894, is one of the preëminent achievements in the domain of medical science. Recent advances have been chiefly significant in demonstrating how diphtheria antitoxin can be more effectively applied in the reduction of mortality and morbidity. The importance of early administration of antitoxin has long been known. The fundamental work of Dönitz (1899), who showed that antitoxin is capable of dissociating toxin which is only loosely

bound to body cells if the time during which the toxin has been in contact with the cell is not too extended, has recently been the starting point of further work by Bieling and Gottschalk.[1] The results of clinical treatment of diphtheria seem to harmonize very well, also, with the experimental view that the curative action of diphtheria antitoxin is in inverse proportion to the duration of the disease before treatment is begun.

The observations of Morgenroth and Levy (1912) in reference to the variation in concentration of antitoxin in the blood depending upon the route of injection as well as those of Henderson-Smith (1907) upon the absorption of antitoxin in the body, have been of very great practical importance. Add to these the experience of Park and his colleagues and certain very clear-cut conclusions emerge, these are: The day of the disease on which treatment is begun and the mode of administration of antitoxin and the size of the dose are the important considerations which will determine the ultimate outcome in every case of diphtheria. Evidence shows that intravenous administration yields most prompt results. If, however, it cannot be resorted to intramuscular injection should be carried out; and if possible the subcutaneous route should no longer be deemed suitable.

The question of the size of the dose to be administered has naturally given rise to much difference of opinion. The amount necessary in any given case cannot be ascertained with experimental exactitude. Indeed, the clinical experience and judgment of the physician will largely determine whether a single dose or multiple doses will be given. Admittedly a single adequate dose at the earliest possible moment is the ideal procedure. But let us assume

[1] These authors recently (1923) have shown, among other things, that, in animals given large injections of toxin, three phases in the subsequent developments may be observed: During the first, concentration of toxin occurs in certain organs, notably the spleen; this is followed by elimination in the urine (but none in bile or through the intestines) and finally a fixation by body cells of the balance of the toxin, which has neither been eliminated nor can be extracted from organ emulsions. The fraction of the injected toxin which cannot be recovered or accounted for except in this way is very considerable. They think that toxin elimination, loose-binding and firm fixation may, indeed, be proceeding synchronously. They believe (although they have not advanced experimental proof to substantiate it), also, that the firm binding of toxin to body cells which follows the loose-binding cannot be disrupted—that is, such "firm bound" toxin cannot be inactivated.

that a dose which the physician believes (he cannot know) is an adequate one proves not to be; then, of course, a further dose must be given.

Apart, then, from the considerations emphasized by Dönitz, we are compelled to abide by the results of clinical experience as to what is a suitable dose. Quite likely better results are obtained now than was the case in the early days of serum treatment when the doses were small and possibly inadequate. The tendency to give much larger doses has spread and many of the leading clinical authorities on the subject on this continent give enormous doses in certain cases. Park may be regarded as an advocate of moderate doses. His 1921 recommendations are shown in the following table:

TABLE I.—ANTITOXIN UNITS TO BE GIVEN IN THE VARIOUS TYPES OF CASES

	Mild cases.	Early moderate.	Late moderate and early severe.	Severe and malignant.
Infants, 10 to 30 lbs. in weight; under two years	2,000–3,000	3,000– 5,000	5,000–10,000	7,500–10,000
Children, 30 to 90 lbs. in weight; under fifteen years	3,000–4,000	4,000–10,000	10,000–15,000	10,000–20,000
Adults, 90 lbs. and over in weight	3,000–5,000	5,000–10,000	10,000–20,000	20,000–50,000
Method of administration advised	Intramuscular	Intramuscular	Intravenous	Intravenous

Park has stated that larger doses than those indicated are unnecessary and can do no good. On the other hand, Bie, who is physician-in-chief to the Blegsdam hospital in Copenhagen in a recent article has summarized his experiences and has concluded that very large doses are of value in certain cases, especially if part of the first dose is given intravenously and the balance by intramuscular injection.

Bie gives the following data in regard to the dosage employed by him:

1. "Patients with slight membrane get no antitoxin.

2. "Patients with membrane of <'*medium extent*' receive 4000 to 8000 units on admission. The injection is not repeated on the following days unless the membrane spreads.

3. "Patients with membrane of '*medium extent*' receive 16,000 to 20,000 units when admitted. The injection is not repeated on the following day unless the membrane spreads.

4. "Patients with membrane of >'*medium extent*' under ten years get 30,000 units on admission, and when over ten years 40,000 on admission. If the membrane has not decreased the next day the same dose is repeated.

5. "Patients with '*extensive*' or '*most extensive*' membrane, under ten years, 80,000 units on admission and twelve to twenty-four hours later 60,000 units, another twelve hours later 20,000 units, making a total of 160,000 units.

"When ten years old or over 100,000 units on admission, twelve to twenty-four hours later 80,000 units and again twelve hours later 40,000 units, making a total of 220,000 units.

"Whenever possible 20 cc of the first dose of antitoxin is given intravenously to patients of Groups IV and V (>'medium extent,' 'extensive' and 'most extensive' membrane). Apart from this intramuscular injection only is employed, because the antitoxin injected intramuscularly on admission renders a later intravenous injection superfluous."

Bie has compiled the following table to show the results obtained by him:

TABLE II

	Patients treated.	Died.	Per cent.
In 1896, 1900, 1908, 1915	2648	69	2.6
In 1916	657	10	1.5
In 1917	869	23	2.6
In 1918	968	14	1.4
In 1919	1497	23	1.5
In 1920 and January–February, 1921	2342	21	0.9
From September 1, 1920, to February 28, 1921	1341	10	0.7

In order to show that these results are not due to the fact that a much larger proportion of mild or less severe cases were under treatment, the following table is presented by Bie:

TABLE III.—CURED AND FATAL CASES TOGETHER

("Three groups in which the fatal cases exclusively arise")

	No. of patients.	Group I, per cent.	Group II, per cent.	Group III, per cent.
1896–1915	891	3.5	36.5	60.0
1916–1917	434	4.1	45.2	50.7
1918–1919	556	6.1	30.6	63.3
1920 and Jan. and Feb., 1921 .	553	9.8	30.6	60.0

Group I. Membrane of more than "medium extent."
Group II. "Extensive" membrane.
Group III. "Most extensive" membrane.

This observer continues: "The state of affairs is, therefore, that while the incidence of diphtheria has increased in extent and severity, the mortality has fallen considerably in that year in which very large doses of antitoxin were given, and particularly in the last half-year, when they were administered most consistently, in spite of the fact that the majority of the worst cases were treated in that half-year.

Bie concludes as follows: "With very large antitoxin doses, therefore, we have succeeded."

1. "In entirely avoiding death as a consequence of paralysis of respiration. (2) In reducing the mortality to less than a third of what it was on an average in the years 1896, 1900, 1908 and 1915. Apart from the most severe, extremely toxic cases, diphtheria is reduced to being a disease almost without danger by this improvement in the treatment, and the mortality even of the most severe cases has fallen from 52 per cent in the four control years to 22 per cent in 1920 and the first half of 1921." Bie also agrees with Friedmann (1922) "that paralysis and delayed death can be almost entirely prevented by the use of these large doses."

Madsen has critically examined these results, and in his Harben

Lectures, published in March, 1923, wrote: "All reservations being made in regard to the application of the available material, it seems warrantable to consider it as an established fact that by application of very large doses of serum partly intravenously (up to 200,000 units and more) our Blegsdam Hospital has succeeded in reducing the mortality to a rate lower than previously seen—that is, has succeeded in saving the lives of some severely attacked patients who would have died if they had not been subjected to such intensive serum treatment."

Madsen carried out certain experiments in connection with the clinical studies of Bie, and he believes, in consequence, that what is observed is "an actual curative process, a neutralization of toxin which has already been bound in the organism." Madsen, of course, as well as Bie, recognizing that even huge doses of antitoxin are ineffective when the firm union of toxin and cell has been established, and irreparable damage done, before the administration of any antitoxin. Bingel, in 1918, published a paper in which he gave the results of the treatment of one series of cases of diphtheria with antitoxin and another with normal horse serum. This "normal" serum was not tested, however, for the presence of natural antitoxin. Bingel claimed that no difference in the results obtained could be observed. Meyer (1920), Herzfeld (1919), Feer, Albrecht, Czerny, Barhoff, Rozowski, Schwendenbecher and Joannovics have been unable to substantiate Bingel's conclusions.

Prevention of Diphtheria. It is possible here to consider only certain aspects of the subject of *specific* prevention of this disease. Purely administrative measures as well as those of a surgical character (as in the treatment of carriers) will not be dealt with. Effective methods for the control of any communicable disease, through specific immunization, depend upon two sets of factors. In the first, questions as to the certainty and simplicity of the immunizing method are of the utmost importance, and in the second are involved those considerations which may inhibit entirely, or largely nullify, the efforts of those responsible for the widespread employment of the method. No one competent to express an opinion can question

the absolute necessity for, and the established value of, vaccination in the control of smallpox. It is equally evident, however, that this most important measure is becoming not less, but year by year more difficult to apply in very many communities. These facts are of more than academic interest. Every physician and public health authority has to face them squarely. Very early in the development of serum therapy in diphtheria the possibility of passive immunization by the injection of diphtheria antitoxin was shown, first by Behring in 1890 and since that time by many others. The inherent limitations in this method of specific prophylaxis have been multiplied as the years have gone by until now some authorities would practically exclude it as a weapon of defence against this disease. Doull and Sandidge (1924), in a statistical study made in Baltimore, have shown that this may be a mistake. In a careful investigation of secondary cases of diphtheria occurring in contact groups where passive immunization was or was not practised, they have found that in the second group 10 per cent of the family contacts developed diphtheria as against 1.2 per cent among those who had received a prophylactic dose of diphtheria antitoxin. It is probably desirable to continue to use all known defensive weapons against this disease and not certain select ones.

Abel, in 1894, demonstrated the presence of natural antitoxin in the blood of man. We are still, thirty years later, uncertain as to (1) how this develops, (2) why there are such extreme variations in the natural antitoxic content of different individuals living under the same general environmental conditions, and (3) the possible fluctuations in the natural antitoxic content of those with either a very slight or a considerable quantity. Very soon after Abel published his findings it was shown that natural antitoxin was also present in certain secretions, such as milk, and could be transmitted through this to offspring. It was also found that placental transmission in human beings could take place. The greatest progress in our knowledge of this subject has been consequent upon Römer's (1909) development of a relatively simple technic for the demonstration of small quantities of anti-

toxin, and Schick's application of this in 1913 to man himself. Since that time much has been learned.

In addition to the above methods one other must be noted. Kellogg (1922) has suggested, on the basis of Römer's procedure, a very useful modification by means of which susceptibility or immunity can be shown by combining with a $\frac{1}{300}$ L + dose of toxin a small amount of the patient's serum, injecting the mixture intracutaneously into a guinea-pig, thus revealing the presence or absence of $\frac{1}{30}$ of a unit of natural antitoxin in each cubic centimeter of serum. No pseudo- or paradoxic reactions are encountered in using the Kellogg method.

While we are not yet in possession of facts as to the possible fluctuations in the natural content in the same individuals of various age groups, of different social grades and living under very different environmental conditions, we have considerable data on other points. Von Gröer and Kassowitz (1915–1919), in a series of studies, have investigated the incidence of natural antitoxin. This is shown in the following figure:

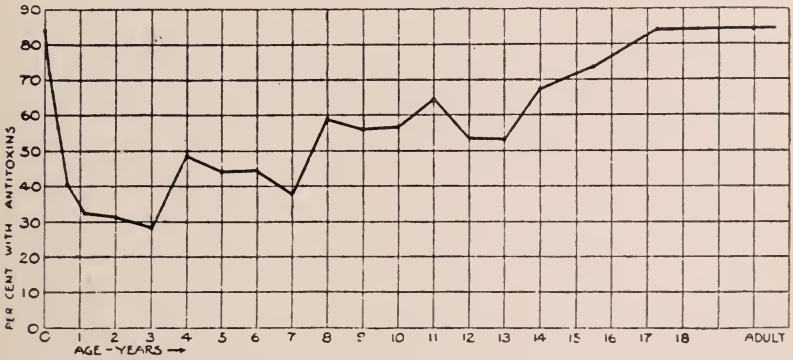

Fig. 1

The estimation of various quantities of natural antitoxin by exact measurement is very laborious and time-consuming. In consequence our ideas as to the content necessary to provide natural immunity (which is very generally believed to be the result

of the possession of such natural antitoxin) are based largely on the results of Schick tests. A few investigators, however, have ascertained the exact antitoxic content in Schick negative individuals. Shick himself (1913) found that natural immunity as revealed by a negative Schick test is the result of the presence of $\frac{1}{30}$ unit (or more) of antitoxin. Kolmer and Moshage in 20 Schick negative individuals found $\frac{1}{20}$ of a unit or more while 10 Schick positive reactors had $\frac{1}{40}$ of a unit or less. Previous to the employment of the Schick test for this purpose, Behring (1914) expressed the view that from $\frac{1}{100}$ to $\frac{1}{40}$ of a unit would confer protection. It seems that the Schick test as carried out by different workers may reveal from $\frac{1}{40}$ to $\frac{1}{60}$ of a unit of antitoxin. (Andrews, Bulloch and others.) Bieber, in 1921, found that $\frac{1}{20}$ of a unit per cubic centimeter protects guinea-pigs against one fatal dose of toxin. The most elaborate comparative study is that of von Gröer and Kassowitz, and their results are shown in the following table:

TABLE IV

Age.	No. tested.	Per cent without antitoxin (Römer's method).	Per cent positive to Schick's reaction.	Per cent, difference.
0	143	16	4.9	+11.1
3 months	57	29	28.0	+ 1.0
6 months	30	44	43.0	+ 1.0
9 months	32	60	59.0	+ 1.0
12 months	68	68	70.0	− 2.0
2 years	54	69	72.0	− 3.0
3 years	50	72	74.0	− 2.0
4 years	60	52	53.0	− 1.0
5 years	50	56	66.0	−10.0
6 years	52	56	63.0	− 7.0
7 years	58	63	72.0	− 9.0

In this series von Gröer and Kassowitz did not use heated toxin controls in the performance of the Schick test. In consequence of this, the positive results above the age of four years are prob-

ably too high, there being included with the positives a number of pseudo- or paradoxic reactions. The same results are shown in the following figure:

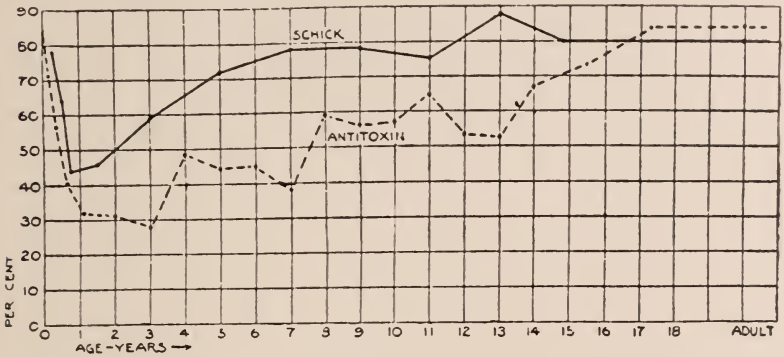

FIG. 2

The table on p. 122 has been compiled by Andrews, Bulloch and others to illustrate the proportion of Schick positive individuals at various ages.

Practically all the estimations of natural immunity, either by direct determination of content or by the Schick test, have been made upon special groups in the community, namely: Persons attending out-patient clinics, inmates of institutions or school-children, and are therefore not necessarily truly representative of the population as a whole.

The whole question as to the constancy of the immune state as revealed by Kellogg or Schick tests cannot yet be answered. While authentic instances of Schick negative individuals developing diphtheria are not common, it has been observed. Naturally the intensity and frequency of exposure to infection will determine whether the antitoxic barrier can be broken down. The conversion of susceptible into immune individuals is presumably going on at all times in communities where diphtheria is prevalent. We may infer this from the variation in the percentage of immune persons in different age-periods.

TABLE V.—SHOWING THE NUMBER OF SCHICK TESTS CARRIED OUT BY DIFFERENT AUTHORS UPON PERSONS OF VARIOUS AGES AND THE NUMBER POSITIVE IN BRACKETS.

Age, years.	Kolmer and Moshage (1915).	Zuckerman (1915).	Moody (1915).	Moffett and Conrad (1915).	Park and Zingher (1916).	Weaver and Rappaport (1916).	Shaw and Youland (1916).	Zingher (1917).	L. T. Wright (1917).	C. A. Johnson (1918).	Zingher (1918).	Blum (1920).	Total.	Per cent. positive.
0	....	....	31(11)	....	....	....	....	101(10)	....	....	....	97(21)	229(51)	22
	25(3)	52(20)	....	20(6)	....	....	66(31)	....	....	....	....	....	163(60)	36
1	....	....	17(5)	....	....	....	....	84(44)	....	....	....	115(72)	216(121)	56
	21(9)	104(67)	36(27)	27(9)	....	....	29(17)	52(24)	....	....	....	221(113)	490(266)	54
2	....	....	....	54(23)										
3	18(12)	124(59)	63(30)	....	62(20)	....	....	127(45)	....	....	....	409(151)	904(374)	41
	....	....	....	47(24)										
4	....	....	....	44(22)										
5	12(7)	214(91)	76(43)	....	318(82)	....	....	348(56)	....	....	....	234(49)	1274(360)	28
	....	....	...	28(10)										
6	....	....	....	42(23)										
7	14(8)	....	115(51)	....	444(97)	....	....	366(30)	....	....	....	....	1113(249)	22
	....	....	....	41(22)	....	....	....	91(18)						
8	....	....	....	25(12)										
9	....	....	....	....	596(135)	....	....	170(22)	....	....	....	....	820(185)	22
	....	....	....	29(16)										
10	....	....	....	21(13)										
11	....	....	....	....	584(125)	....	....	....	....	....	....	....	815(208)	25
	21(5)	....	171(55)	18(10)										
12	....	....	....	17(13)	....	....	....	636(37)						
13	....	....	....	....	506(90)	....	....	....	....	....	....	....	1171(145)	12
	....	....	....	12(5)										
14	....	....	....	30(13)										
15	....	....	....	....	189(31)	....	....	....	....	....	....	....	219(44)	20
20 and over	336(115)	....	45(12)	....	....	194(92)	17(10)	232(17)	210(86)	367(44)	2648(436)	....	4049(812)	20

Glenny and Südmersen, in 1921, as the result of a most interesting experimental study, have postulated what they call "primary" and "secondary stimulus" effects to explain the development of antitoxin under natural and experimental conditions in man and animals. By primary stimulus is meant the first invasion of diphtheria bacilli or the initial elaboration or injection of toxin. After application of the primary stimulus only slight immunity develops. This may come about slowly and be more or less transient. After an attack of diphtheria in certain cases this is observed in the slow development of a little antitoxin which soon disappears. After the application of a secondary stimulus, however (whether this be natural infection or artificial immunization), there is a rapid development of antitoxin, which appears in much greater concentration and is more apt to persist. It is, of course, to be remembered that considerable individual variability exists in respect of the degree of response to either the primary or secondary stimulus, as is seen in all immunity reactions.

Zingher, in 1921, as a result of statistical evidence which showed a very much higher percentage of Schick positive children among those less exposed to chance infection than was found among children living in overcrowded slum districts, concluded that antitoxic immunity is due to slight, unrecognized infection among those constantly exposed. This he designates "contact immunity." Dudley (1923), in a very illuminating epidemiological study, has supplied data bearing on the relationship existing between periods of residence in a diphtherial environment, immunity to diphtheria and outbreaks of the disease. This work was done in a boys' school in which there had been two outbreaks of diphtheria. In all, 831 boys were tested by the Schick method. Some of the boys had been in the school for four years, others for only a few months. The "new" boys had a much higher percentage of susceptible than the "old" boys. On the basis of results obtained among 67 "new" boys and 15 "old" boys, Dudley concluded that 45 per cent of boys who entered the school were Schick-positive, but after ten months' exposure in a diphtherial environment 90 per cent of the positive reactors became negative reactors, although

they did not have recognized diphtheria during that period. During the whole of the ten months, however, diphtheria cases and carriers were recorded in the school. Thus the effect of a known diphtherial environment was to increase the percentage of immunes and Dudley believes that this was due to unrecognized "larval" infection occurring during the outbreaks. These results are shown in the following figure:

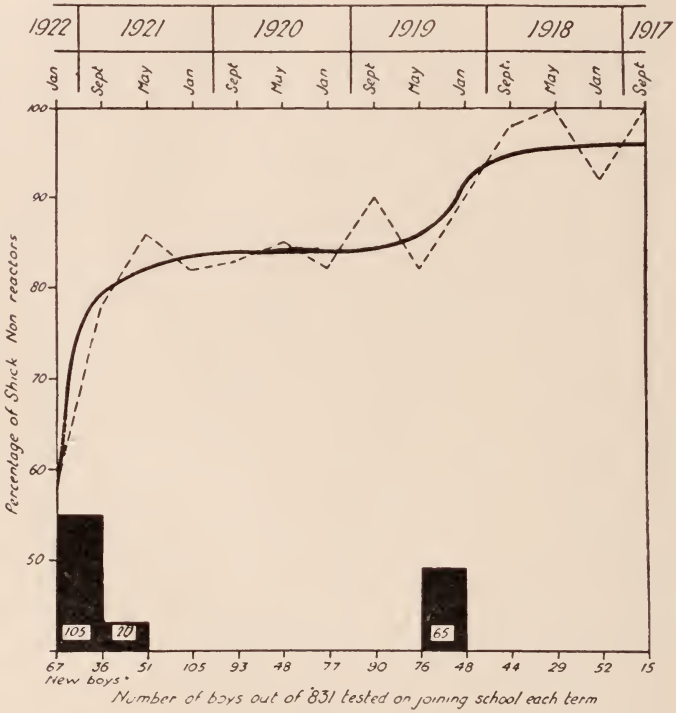

Fig. 3

The interpretation of the Schick test in individuals over fourteen years of age and in adults is often difficult. This is due to what is known as pseudo- or paradoxic reactions. This may make it necessary in such persons to test the actual content. However,

a more interesting feature of these reactions is their relationship to diphtheria immunity. This is shown in the following figure taken from von Gröer and Kassowitz:

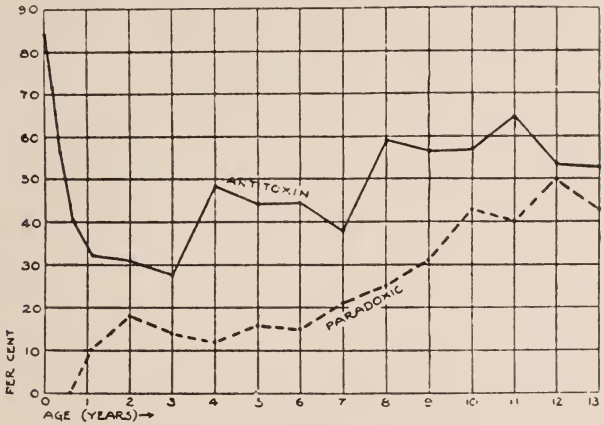

FIG. 4

Zingher and others have also observed that a higher percentage of pseudo-reactions are found among immunes than among susceptibles. Von Gröer and Kassowitz's explanation of this important fact is that a pseudo-Schick or paradoxic reaction is an expression of previous sensitization by diphtheria bacillary substance derived from infection. That is, a paradoxic reaction means previous exposure to infection. Paradoxic reactions can, however, be produced by the injection of broth (Kolmer and Moshage) typhoid bacilli and heated toxin as well as by diphtheria bacilli. (Von Gröer and Kassowitz and Opitz 1921.) From this it would appear that the bacterial sensitization is non-specific. As already pointed out, the reaction is not observed in guinea-pigs. It apparently does not occur in children under one year of age. In addition to antitoxic immunity, Solis-Cohen, Heist and Solis-Cohen (1920) have observed an antibacterial immunity.

Active immunization of man against diphtheria was first suggested by Theobald Smith in 1907. The definite statement that

neutralized mixtures of toxin-antitoxin would be suitable for this purpose was made by the same investigator in 1909. According to Bordet, Babes first made this suggestion in 1898. Von Behring, in 1913, seems, however, to have been the first to actually prepare such mixtures for use in human beings. Others before him had tried toxin alone in isolated instances. It is to Park, Zingher, Banzhaf and their colleagues that the greatest credit must be given for work in this field. From 1914 to 1922 thousands of children have been actively immunized with toxin-antitoxin mixtures of varying toxicity. There are definite indications that the toxicity of the mixtures can be much lower than it was in those first used and satisfactory results still be attained. In a recent publication Schroeder and Park (1923) have set forth results obtained with toxin-antitoxin mixture having $\frac{1}{30}$ of the L + value of their original preparations. Just recently, too (October, 1923), Glenny and Hopkins have proposed the use of "toxoid" (aged toxin further modified by treatment with formalin) and antitoxin as an active immunizing agent, and have also outlined a new method for testing the actual antigenic values of such mixtures.

Most recently Ramon (1924), in a very interesting communication, has suggested the use of highly potent toxin, so modified by heat and formalin that it is no longer toxic but highly antigenic, as an immunizing agent. This modified toxin he designates anatoxin. Some results of the injection of this anatoxin into horses and guinea-pigs are given by Ramon, and if similar results are obtained by other workers, it is possible that a most important advance has been made. An absolutely innocuous, but still highly antigenic immunizing agent, capable of being accurately tested in laboratory animals, is essential. If Ramon had succeeded in this endeavor, as he appraently has done in evolving an *in vitro* method of testing antitoxic values, he is to be credited with the two most important and significant contributions to knowledge made in this field during the past fifteen years.

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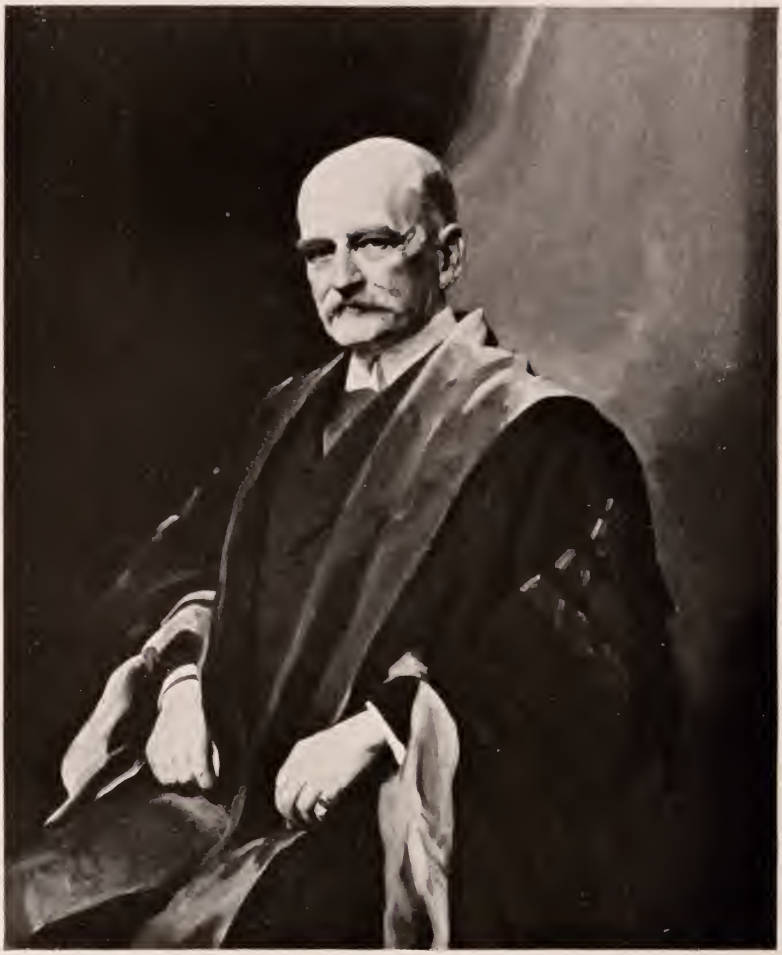

WILLIAM J. TAYLOR, M.D.

ADDRESS ON PRESENTING A PORTRAIT OF EX-PRESIDENT WILLIAM J. TAYLOR, M.D.[1]

By W. W. KEEN, M.D.

It is a great privilege for me to present to the College, on behalf of the Fellows who have so spontaneously provided it, this excellent portrait of our ex-President, Dr. William Johnson Taylor, to show for all future time the esteem in which he is held. It is an especial personal pleasure to me because of the intimate relations we have had for nearly forty years, first, as my valued assistant in my private practice, then as my assistant, and later successor, at the Orthopedic Hospital, and always my dear friend.

Never can I forget one wild, stormy winter night, almost thirty years ago, when he saved my life. I had made a postmortem at noon in an exceedingly virulent case of peritonitis. Just at its close I inadvertently pricked my right thumb with only the point of a needle, barely enough for me to perceive it. I washed it well at once in a bichloride solution and forgot all about it. By early evening I began to feel chilly and went to bed but could not sleep. A little after midnight my thumb began to throb. Then I bethought myself of the needle prick and called Dr. Taylor over the telephone. He came at once, incised the wound to the bone, and thoroughly disinfected it. By morning, less than twenty hours after the accident, my temperature was 105°. My life hung in the balance for two or three days, but finally I escaped. His scar of friendship and good surgery I shall bear as long as I live, and every day it recalls the life-saving service of my dear friend. Could a better instance also be found of the rapidity of development of a streptococcus infection?

But it is more especially fitting that I should recall to your minds Dr. Taylor's services to this ancient and distinguished College.

[1] Read June 4, 1924.

He was elected a Fellow in 1887, became President in 1919 and served for three years. He was a member of the Library Committee for twenty years, and part of the time its chairman. These two offices gave scope to his interest in the affairs of the College and showed how faithfully he discharged his duties.

But it was in the stirring and eventful days when we were compelled, by the rapidity of our growth, to seek a new home that his talents were chiefly enlisted in the development and welfare of the College. He was on the committee to secure a new site. Most fortunately, when this duty became a *fait accompli*, he was made secretary of the building committee. While great praise is due to all the members of this, the most important committee in my fifty-seven years as a Fellow, I am sure that his colleagues will bear me out in saying that to him, as the one who gave more time and thought and care than any other member, this College owes especial homage.

He aided also in raising contributions to the building fund and secured for us the endowment of the Mary Scott Newbold Foundation.

Besides this, as surgeon to the Orthopedic, St. Agnes' and other hospitals, as fellow and as president of the Philadelphia Academy of Surgery, fellow of the American Surgical Association, the American Orthopedic Association, the American Medical Association, the County and State Medical Societies, the International Surgical Society, and as an active author, he has filled a large place.

When the clarion call of the Great War sounded he was one of the early volunteers, entering the service as a first lieutenant and went overseas with Base Hospital No. 10. He was assigned to active service with the British Army in General Hospital No. 16 at Tréport, France, where he served from June, 1917, to January, 1919. He was promoted to grade after grade till he became a lieutenant colonel. He was honorably discharged on February 2, 1919.

We welcome this faithful likeness, by Lazar Raditz, of one who has faithfully served our profession, our College, our Nation, our Allies and the cause of liberty throughout the world.

TRANSFER OF THE CUSTODIANSHIP OF THE RUSH AND OTHER MEMENTOES TO DR. W. W. KEEN[1]

By WILLIAM H. WELCH, M.D.
BALTIMORE, MD.

Dr. Thomas R. Neilson,
President of the College of Physicians of Philadelphia.

My dear Dr. Neilson: I have the honor herewith to transfer the custodianship of the Rush and other mementoes in the "Cabinet of Historic Medical Mementoes of the College of Physicians of Philadelphia" to Dr. William W. Keen. This precious collection and the conception of a custodianship to be passed on in succession to representative members of the profession in accordance with certain provisions we owe to the generosity and the enlightened sentiment of Dr. Robert Abbe, who has wisely selected this College as the repository and possessor of these treasures. As Dr. Abbe refuses to have his name attached to the collection I have adopted above a designation which I understand to be acceptable both to him and to the College, but I venture to suggest that now or later there be added the words: "Founded by Robert Abbe."

It is a source of sincere regret that serious illness prevents the presence on this occasion of one who has rendered such signal service to our profession and who has devoted so much time and thought and substance to the establishment and development of this collection. The name of Robert Abbe, already distinguished by his surgical attainments, shall always be held in grateful remembrance by this College and the profession as the founder and a generous donor of this custodianship collection.

[1] Read June 4, 1924.

In resigning a custodianship, held first by Weir Mitchell and next by Simon Flexner, I desire to record my deep appreciation of the privilege of holding this honorable office, nominal though its functions may be. My pleasure is heightened by the opportunity now presented to pass on the custodianship of these interesting and valuable historical relics to one who is universally honored and loved as the very embodiment of all that is best in the ideals and accomplishments of our profession, to one who in his four score and eighth year is still active with unabated vigor in service to the public and to the profession.

The association of the name of William W. Keen with this collection of medical and scientific mementoes will give for all future time an added dignity and prestige to the custodianship, will contribute to the interest and significance of the collection, and will enhance the satisfaction and pleasure of his fortunate successors in this office.

I remain, my dear Mr. President of the College,

Faithfully yours,

William H. Welch.

Acceptance of the Custodianship

My dear Dr. Welch: I appreciate most sincerely, the high honor of becoming one in such a distinguished a series of the custodians of the cabinet of historic medical mementoes of the College of Physicians of Philadelphia.

It is an especial honor to succeed the famous father of Pathology in America.

It is also a unique honor for, so far as I know, there is no similar collection of medical memorabilia of the few greatest masters of medicine.

I gratefully accept the office and will at once deposit with the Secretary of the College a sealed envelope containing the name of my successor.

I have the honor to be

Yours faithfully,

W. W. Keen.

THE CLINICAL ASPECTS OF ERYTHREMIA*

By T. B. FUTCHER, M.B.
BALTIMORE, MD.

In the consideration of a subject to bring before your society for discussion, I thought it would not be without interest to present some data concerning the interesting disease now generally termed erythremia. American investigators have played a rather prominent part in bringing the disease and its essential features to the attention of the medical profession. In Osler's[1] original communication, in 1903, in which he described the disease as a new clinical entity, he reported 4 cases of his own and 5 collected from the literature. Of these 5, 2 were published by Richard Cabot,[2, 3] of Boston, in 1899 and 1900 respectively, and 1 by McKeen,[4] of Boston, in 1901. Subsequently, the condition has been the subject of investigation by Reginald Fitz[5] and quite recently by Minot and Buckman,[6] who, in 1923, published a most important contribution dealing with the morphology and physical characteristics of the blood, which has thrown much light on the etiology of the disease. Bock and Means have published studies on the blood gases. Christian has laid emphasis on the nervous manifestations. It should be mentioned here that of the 2 remaining cases reported by Osler in his original communication, 1 was published in 1892 by Vaquez,[7] of Paris, whose name has also been given to the disease, the other by Saundby and Russell[8] in England, in 1902. Ever ready to give due credit to investigators, Osler, in his original paper, quotes the latter authors as saying that their case probably represented "a definite clinical entity, and one which is new to medical science."

* Read October 1, 1924.

In the literature the affection has been variously termed Vaquez's disease, Osler's disease, polycythemia vera, polycythemia rubra, splenomegalic polycythemia, myelopathic polycythemia, polycythemia with chronic cyanosis, erythrocytosis megalosplenica and polycythemia hypertonica by Gaisböck. These names are gradually being superseded by the more appropriate and descriptive term "erythremia," which was first suggested by Türk, of Vienna. As Osler[9] stated in his third paper on the disease in 1908, "it has the great advantage of an analogy with leukemia, and both affections are associated with states of morbid activity in the bone-marrow."

The essential features of the disease were concisely summarized by Osler in his original communication as follows: "The condition is characterized by chronic cyanosis, polycythemia and moderate enlargement of the spleen. The chief symptoms have been weakness, prostration, constipation, headache and vertigo."

It may not be out of place to state here that it has been the experience of the writer that the great majority of these cases enter the large general hospitals unrecognized, and it is not inappropriate, therefore, that the disease should be brought again to the attention of physicians in active practice who are likely to be first consulted by the patient. The affection is oftenest mistaken for hypertension, chronic Bright's disease, arteriosclerosis, apoplexy, neurasthenic states and eye affections, which are merely associated manifestations or complications of the disease.

The malady is not as rare as was formerly supposed. It is a peculiar fact that the Johns Hopkins Hospital, which was opened for the admission of patients in May, 1899, and where rather systematic blood examinations have been the rule from the beginning, there were 11,554 medical admissions up to July 11, 1900, before the first case of "polycythemia" was diagnosticated. This was Case II in Osler's original series, Case I being a patient in his private practice. From this date on the cases became more numerous, as attention became riveted on the disease. Up to May 1, 1924, there have been 32 cases admitted to the wards out of a total of 51,080 medical admissions. I have analyzed

these cases and reference will be made to this series in the text. In the brief time at my disposal no attempt is made at a thorough discussion of the affection, only salient features being dealt with.

The cases of polycythemia may be divided into two groups:

1. Secondary polycythemias, which are dependent on some discoverable cause, and

2. Erythemia or polycythemia vera.

Under the secondary polycythemias may be mentioned the following groups:

1. Those in individuals in high altitudes, where the hyperglobulism is dependent upon deficient oxygen, resulting in increased activity of the bone-marrow:

2. Polycythemia of congenital or valvular disease of the heart.

3. Those in association with emphysema.

4. Those due to concentration of the blood resulting from protracted emesis, diarrhea or diuresis.

5. Those resulting from the action of various organic or metallic poisons.

6. The experimental acute polycythemia of Lamson following the injection of adrenalin, in which the drug is believed to stimulate the liver to give up its reservoir of red cells to the general circulation.

It is with erythremia or polycythemia vera—in other words with the cases in which there is an actual overproduction of red cells—that we are concerned in this paper. As experience has accumulated there has been a tendency to subdivide the cases into various groups. The following subdivisions have been suggested:

1. Cases without enlargement of the spleen.

2. Cases which appear to be congenital or appear in early life.

3. The cases of polycythemia hypertonica of Gaisböck. This is a type occurring in elderly patients with hypertension, arteriosclerosis, cardiac hypertrophy, albuminuria and without splenic enlargement.

It may be well to emphasize here that considerable variation takes place in the size of the spleen in the course of the disease,

dependent, possibly on increased destruction of red cells which may occur spontaneously. With the increased blood destruction the spleen enlarges. It would therefore seem that we should be on our guard in using the size of the spleen as a factor in classifying the cases.

Sex. Males are much more often affected than females. In our series there were 25 of the former and 7 of the latter.

Race. The colored race appears to experience a relative immunity. There was only 1 colored case among the 32. The ratio of colored to white admissions is about 1 to 7.

Age. Our youngest patient was twenty-one years of age (a colored man) and the eldest was sixty-eight. Divided into decades there were from twenty-one to thirty, 3; thirty-one to forty, 11; forty-one to fifty, 9; fifty-one to sixty, 6; and sixty-one to seventy, 3. The largest number, 11, therefore, occurred in the fourth decade, *i. e.*, between thirty-one and forty years. Further, in the fourth and fifth decades, in other words from thirty-one to fifty years of age, there was a total of 20 cases, or nearly two-thirds of the total.

Symptomatology. It is very difficult to form any clear impression as to how long the affection has existed before the case first comes under observation. It seems probable that it has been present a considerable time before the patient begins to experience subjective symptoms. The initial complaint varies greatly. Headache seemed to be the most frequent symptom in our series. It was a marked feature in 10. Attacks of dizziness are frequent and were emphasized by Osler. This is often accompanied by a sense of fulness in the head and sometimes by roaring in the ears. Visual disturbances, such as transitory dimness of vision or specks before the eyes, are not uncommon. Not infrequently there is a sense of fulness or numbness in the hands. At times there may be transitory weakness in one or other extremity. The patients sometimes complain of a sense of fatigue and an incapacity to perform their ordinary duties. These features, especially if there be accompanying hypertension, frequently lead to an incorrect diagnosis of primary arteriosclerosis. Pains in the back

and cramps in the muscles of the lower extremities are occasionally complained of.

The symptoms with reference to the alimentary tract are very conspicuous. Constipation, often of the most obstinate character, is the most prominent one. It was present in 14 cases. The first patient of the series had not had a movement for eight days before admission, and on one occasion he stated that his bowels had not moved for fourteen days. Another patient stated that his bowels moved four times per month. There may be anorexia, nausea and vomiting. Abdominal pain was complained of in 12.

The vascular features are prominent and are the most serious from the standpoint of risk to life. Moderate or marked thickening of the peripheral arteries was noted in 21. Varying degrees of enlargement of the heart was present in 15. Mitral insufficiency, probably always relative and indicated by a mitral systolic murmur, occurred in 8. Mitral stenosis occurred once, but it was probably dependent upon some previous infection. It is interesting that there was not a single case with aortic insufficiency. It is a significant fact that in 20 cases in which the Wassermann test was done since it came into routine use there was not a single instance with a positive reaction. As our hospital population shows about 30 per cent with positive Wassermann these negative findings are striking, and, considering the tendency to cardiovascular manifestations, it may help to explain the absence of any cases with aortic insufficiency. One patient had an aortic aneurysm with negative Wassermann.

Vascular lesions of the brain were prominent; 6 of the 32 cases had hemiplegias. Three were right sided and 2 left. In the remaining case the patient was admitted in an unconscious condition and lived only a few hours. The muscles were so flaccid the side of the paralysis could not be definitely determined. Owing to the slowness of the development of the paralysis all the hemiplegias were believed to be due to cerebral thrombosis. As further evidence of the proneness of these cases to vascular lesions was the occurrence of extensive bilateral varicose veins of both legs in 2 cases, which suggested that venous thrombosis had

occurred, the development of an acute phlebitis without fever in the last case admitted and the existence of varicocele in 2 others. One patient had a mesenteric thrombosis terminating fatally after operation.

That the disease is not by any means constantly accompanied by hypertension is shown by the fact that when one considers the age of the individual patients there were only 12 in which the blood-pressure was increased. The highest systolic blood-pressure was 240 mm. of Hg. in a woman. The highest diastolic pressure was 150.

With reference to the renal system, albuminuria of varying degree was present in every case. Hyaline and granular casts occurred in 21. These urinary findings not infrequently lead to a diagnosis of nephritis. Phthalein determinations were recorded in 7 cases. In 5 there was a diminished output ranging between 15 and 43 per cent for two hours; normal in 2. Diabetes occurred in 2 cases. In a third case, the patient with mesenteric thrombosis, in which the autopsy showed thrombosis of the portal radicles in the liver, glucose was present in the urine.

Hemorrhages not infrequently occur. One of our series had a severe hemoptysis without any physical signs of tuberculosis. Hematemesis has been recorded. One of our cases had a severe gastric hemorrhage, but there was a very suggestive history of duodenal ulcer. A severe hematuria occurred in 1 of the cases before admission and 3 other cases had red blood cells in the urine on microscopical examination. Another case recently had an annoying hemorrhage from a ruptured venule on his face. Bleeding from the nose and gums, hemorrhages into the brain, the pleural and peritoneal cavities and into the skin or subcutaneous tissues have been recorded.

Osler has pointed out the tendency to pigmentation of the skin in these cases with prolonged cyanosis.

Physical Signs. (1) *Cyanosis.* Although chronic cyanosis is a constant and conspicuous feature of the disease it is rarely mentioned by the patient among his symptoms. The color is usually very striking. The patients usually present a cherry-red color

of the face and hands. The backs and palms of the hands often show a red brick-dust tint. In some there is a suggestion of a plum-blue hue to the face and hands. When one studies the color more closely one will find that it is contributed to by various degrees of dilatation of the venules of the face, ears, hands, and often also of parts of the trunk. The venules of the lips, buccal mucous membrane, tongue, pharynx, inner surface of the eyelids and sclerotic coats of the eyes show the same dilatation. Ophthalmoscopical examination reveals the same changes in the fundi with marked enlargement of the main venous trunks. It is this venous dilatation that is so characteristic of this type of cyanosis. In every full-blooded, plethoric-looking individual close inspection of the condition of the venules should be made. Presence of innumerable dilated venules should put us on our guard and lead us to have a full blood count made, with the probable result that a polycythemia will be found. Cold tends to increase the cyanotic tint. Raising the hand above the head often causes prompt blanching, with a sudden return of the color on lowering it. The stasis is well seen in the dependent feet.

2. *Splenomegaly.* Enlargement of the spleen is found in a certain proportion of the cases. It is not by any means a constant feature, as has already been intimated. It was enlarged in 19 of our series. The degree of enlargement varied greatly from a merely palpable gland to one which extended 15 cm. below the nearest point of the costal margin. The enlargement of the spleen is probably in part analogous to the splenomegaly in myelogenous leukemia, but is probably also in part due to the increased blood destruction it is called on to perform, as Weber[10] has pointed out.

3. *Enlargement of the Liver.* The liver may show moderate enlargement in a certain percentage of cases, even when it cannot be explained on the basis of a chronic passive congestion due to associated cardiac disease.

4. *Polycythemia.* The study of the blood constitutes the most interesting and important aspect of the malady. Time will not permit more than a brief reference to the salient features.

The outstanding feature of the blood picture is the striking increase in the number of red cells which occurs at some period during the course of the disease. The count varies in each individual case as the patients show a tendency to spontaneous remissions and relapses. The highest count in our series was 13,200,000. The average of the highest counts on any of the admissions was 8,873,000 in the 32 cases. The highest red count I have seen recorded was 14,800,000 per c.mm. in a case published by Tancré.

There is frequently a considerable leukocytosis. In only 6 was there a normal count. The lowest count was 4800; the highest, 45,750. The average of the highest counts recorded in each of the 32 cases was 15,426 per c.mm. The characteristic feature in the differential blood count seems to be a slight increase in the polymorphonuclears. In 26 of the 32 cases in which there were records of differential counts the percentages were as follows: Small mononuclears, 15.2; large mononuclears, 4.1; transitionals, 0.7; polymorphonuclear neutrophiles, 79.2; eosinophiles, 1.5; basophiles, 0.5. Other interesting findings in the differential counts were the fact that in 1 case 2 normoblasts and in 2 cases 1 megaloblast was observed in each. In 6 occasional myelocytes were found. In 1 case 2 per cent of neutrophilic myelocytes were observed.

Although the statement in our differential counts was usually to the effect that the red cells showed no changes, microcytosis and macrocytosis and achromia and polychromatophilia of the red cells have been noted, as described by Minot and Buckman. In 1 of our cases, studied by Lamson, 9 per cent of reticulated red cells were found.

The platelets have been recorded as diminished, normal or increased. The general impression, when accurate counts by reliable methods have been made, is that they are increased. There are only two counts recorded in our series. One showed 252,000 and the other 400,000, the latter showing a moderate increase.

The hemoglobin usually shows a striking increase. It generally ranges between 120 to 150 per cent. The highest record of our series is 220 per cent. Although this patient had 12,800,000 red

cells, one would be strongly inclined to doubt the accuracy of the Sahli instrument used. Bock and Means, however, have also recorded a case with 220 per cent. The next highest determination was 175 per cent. The average of the highest determination in our 32 cases was 124 per cent. The color index of the blood is below normal and was 0.7 in our series.

The total volume of blood is increased in erythremia. By the Haldane and Smith[11] carbon monoxide method the reported figures have reached as high as three times the normal figure corresponding with the patient's weight. Bock and Means have confirmed this increase. In 1 case the blood volume by the vital red method was 8545 cc, or 124 cc per kilogram of body weight instead of the normal 85 cc. In another the blood volume was 6659 cc, or 118 cc per kilogram body weight. This increase in blood volume is almost entirely due to the increased bulk of red cells and not due to an increase of the blood plasma. This can be demonstrated by the hematokrit as well as by the total plasma volume. Normally the corpuscles represent about 46.8 per cent and the plasma about 53.2 per cent of a volume of blood, while the total plasma volume is between 42 and 56 cc per kilogram of body weight. In erythremia if the blood is allowed to stand for several hours almost no plasma comes to the surface, and if the hematokrit is used the figures may reach 73 per cent of cells and 27 per cent of plasma.

As to the physical characteristics of the blood it appears very dark as it flows from the point of puncture. The specific gravity and viscosity of the blood are considerably increased. The coagulation time seems to vary, being increased or diminished according to various observers without having any direct relationship to variations in the red count. The time was not increased materially in the cases in our series in which it was estimated.

With regard to the fragility of the red cells, Minot and Buckman make the following statement:

"The influence of the polycythemic process on the red corpuscles is evidenced by the deportment of these cells when placed in hypotonic sodium chloride solution and in hypotonic blood

serum. These tests show abnormalities indicated below but do not give necessarily parallel results.

"(*a*) A lengthening of the resistance range is often observed.

"(*b*) An increased, normal or decreased initial hemolysis (point of minimal resistance) may occur.

"(*c*) Complete hemolysis (point of maximal resistance) never occurs in more concentrated solutions than normal.

"(*d*) Patients' cells in dilutions of their own or normal serum may yield an abnormally long resistance span and may break up in dilution of an equivalent of a stronger concentration of sodium chloride than normal.

"(*e*) Normal cells may hemolyze in dilutions of patients' serum more readily than their own. The resistance range in either serum is less than that of erythremic cells.

"Hence the erythremic serum may exert a hemolytic influence on red blood corpuscles; in a case of erythremia, some of the cells may be more vulnerable than normal and others distinctly less so.

"It is suggested that lengthened resistance span in fragility tests is due to cells of a greater age variety than normal; that an increase of resistance, especially the maximal resistance, is dependent upon an increase of some of the immature cells; and that decrease of minimal resistance is indicative of some hemocidal influence on the cells, or perhaps due to a relatively large number of old or pathological cells."

As in leukemia, so in erythremia, it has been found that the metabolic rate is increased. A satisfactory explanation for the increase has not been advanced up to the present, but it is believed to be due to the hyperactivity of the bone-marrow.

With regard to gas exchange I quote the following from Fitz:

"The volume of air breathed per minute tends to be increased, as shown in the cases reported by Senator and by Means and Bock, which varied between 8 to 5 liters and 11 to 5 liters, figures considerably in excess of the average normal. Thanks to such ventilation, the arterial blood is normally saturated with oxygen (98 per cent in Senator's case and in that of Bergman and Plesch), or approximately so (96 per cent and 93.3 per cent in the cases of

Means and Bock), so that owing to the increased blood volume the total oxygen in the arteries is much increased. The need of the cells is no greater than normal, therefore, the venous blood is almost as rich in oxygen as is normal arterial blood, and the 'coefficient of utilization' of oxygen is much reduced. Röver found in 1 case, which died shortly afterwards, a remarkably low 'coefficient of utilization' and attached great prognostic significance to the finding. His observation has not been confirmed."

Estimation of the volume output of the heart has given somewhat varying results. Senator reports a case in which it was 65 cc to the minute, Bergman and Plesch one of 54 cc and Means and Bock one of 71 cc, all showing either a normal or abnormally high cardiac output. However, as the blood volume is so much increased and the rate of flow approximately normal, the circulation as a whole is relatively sluggish and there is considerable stasis. This may be a factor in causing cases of erythremia to show an increased predisposition to thrombosis.

When followed for long periods cases of erythremia show considerable variations in the blood picture. As noted above, fluctuations in the red count take place spontaneously. Minot and Buckman have recorded 3 cases, which, after having had polycythemia for several years, developed anemia, coincident with a further increase in the size of the spleen and a leukemic blood picture. These cases were all in women who had had erythremia for years with a count ranging between 7,000,000 and 10,000,000. Within the course of a year all 3 cases had a drop in the red count to 5,000,000 and the hemoglobin to about 85 per cent. Two of the cases before exitus had a fall in the red cells to 2,500,000 and the third case still living had a count of 3,500,000. Nucleated cells became numerous, and in 1 of the cases whose leukocytes rose to 35,000 the differential count simulated strongly a myelogenous leukemia with 10 per cent of myelocytes.

These observers also noted an increased urobilin output in the stools in these cases, which, with a coincident marked increase in the size of the spleen in all 3 cases, pointed toward a possible increased blood destruction.

Etiology and Pathology. The prevailing view as to the etiology of erythremia is that it is due to a hyperplasia of the erythroblastic bone-marrow just as myelogenous leukemia is dependent upon a hyperplasia of the leukoblastic tissue. The increased activity of the bone-marrow is emphasized by the increase in the peripheral blood of all three formed elements—erythrocytes, leukocytes and platelets, as Minot and Buckman have emphasized. These investigators, as well as Blumenthal[12] before them in 1907, have pointed out an occasional close relationship with myeloid leukemia. The former observed a typical erythremia case which in its later stages developed an anemia with a differential leukocyte count suggesting a transformation to a myelogenous leukemia type with 10 per cent of myelocytes in the circulating blood. In Blumenthal's case the reds were 11,450,000, the hemoglobin 110 per cent and the leukocytes 16,300, of which 45 per cent were myelocytes. At the autopsy the leukoblastic elements of the bone-marrow resembled leukemia more than erythremia. Rosin[13] has recorded a case almost identical with that of Minot and Buckman. On the other hand Winter[14] has presented a case with the converse picture. At the first observation it presented the features of a myelogenous leukemia with 4,000,000 reds and 22,600 leukocytes. Three years later the patient had 8,000,000 red cells, but the white count was unchanged. It has been suggested that both erythremia and myelogenous leukemia may be of neoplastic nature. The development of the anemia in erythremia, as in leukemia, has been suggested by Minot and Buckman as being dependent upon a "disorderly proliferation" of the myeloid tissue.

Although the prevailing view is that the polycythemia in erythremia is due to an abnormal increased production of red cells by the hyperactive erythroblastic bone-marrow, Richards and Herrman,[15] on the basis of a case studied, advanced the view that the hyperglobulism may result from lack of normal red cell destruction, and that this may be due to an abnormally high serum cholesterol content which was present in their case and which they claim preserves the life of the red cells. They claim that

cholesterol is strongly antihemolytic, and cite the work of Gorham and Myers, who found a low cholesterol content in the blood of pernicious anemia patients.

At autopsy the bone-marrow, grossly, is shown to have retained its fetal red appearance in almost all the bones. Microscopically it shows, in addition to congestion, hyperplasia of both the erythroblastic and leukoblastic elements. This was the case in the only patient in our series in which the bone-marrow was secured for examination at autopsy. The spleen, though often enlarged from engorgement of blood, is normal histologically.

Course. The disease is chronic, lasting for many years, with a tendency to spontaneous remissions and exacerbations, but is ultimately fatal. Patients usually die from intercurrent disease, generally from vascular accidents. Five of our 32 cases died while in the hospital. Three died with hemiplegia due to cerebral thrombosis, 1 from a mesenteric thrombosis, and in the fifth the cause could not be definitely determined, as no section was permitted. Death in the latter case was preceded by great asthenia, but was not apparently due to cerebral or cardiovascular complications. How the prognosis and course will be influenced by the latest method of treatment remains to be seen.

Treatment. Until quite recently the treatment of the disease has been eminently unsatisfactory. The measures adopted, heretofore, have been quite transitory in their effects, but have been helpful in temporarily relieving the headache, vertigo, fulness in the head and sense of tingling and numbness in the hands. The therapy that have been recommended may be enumerated as follows:

1. *Splenectomy.* This has been abandoned owing to its failure to give either transitory or permanent results.

2. *Oxygen.* Oxygen inhalations have been tried without very satisfactory results.

3. *Venesection.* The repeated removal of from 500 to 800 cc of blood almost invariably gives material relief to the subjective symptoms and may cause a decided drop in the cell count. It was carried out in 9 of our cases. The best results were obtained

in a woman who entered with 10,304,000 reds, 16,000 leukocytes and 130 per cent of hemoglobin, who, after several bleedings to a total of 2400 cc, left the hospital with 5,112,000 reds, 18,000 leukocytes and 95 per cent of hemoglobin and with decided improvement in the subjective symptoms.

4. *Radium and X-ray Therapy to the Long Bones and Spleen.* In 2 of our cases radium treatment of the spleen and in 2 deep *x*-ray treatments of the long bones were applied with temporary improvement in the subjective symptoms and blood count. It would seem that best results would naturally follow the treatment of the long bones.

5. *Benzol.* Since Korany introduced benzol as a means of treating myelogenous leukemia on the basis that it reduced the activity of the hyperblastic bone-marrow, this drug has not infrequently been prescribed in erythremia, with the view of retarding the formation of new red cells. It often has a striking effect on the blood count. McLester has reported satisfactory results. It was used in 3 of our series with material reduction in the red cells.

In one of my personal cases included in the series a combination of venesection, deep *x*-rays to the long bones and benzol was utilized. Although on his first admission he had 7,880,000 reds, 10,500 leukocytes and 133 per cent of hemoglobin, he had already shown some spontaneous improvement on his third admission without treatment. His count then was 6,100,000 reds, 5900 leukocytes and 105 per cent hemoglobin. The above combined treatment was then started and at the end of a month he left with 4,310,000 reds, 5000 leukocytes and 85 per cent hemoglobin. He felt infinitely better and the cyanotic, congested appearance had almost entirely disappeared. Without further treatment he returned eleven months later with 5,568,000 reds, 10,000 leukocytes and 105 per cent hemoglobin, and feeling better than he had for years. This patient before his second admission had had a hemiplegia with motor aphasia from cerebral thrombosis, from which he entirely recovered. Before his first admission he came to us with a diagnosis of chronic Bright's disease.

Should benzol be used, the precautionary advice must be given to watch the leukocyte count in order that a marked leukopenia be avoided.

6. *Phenylhydrazine Hydrochloride.* The use of this drug, which seems to be meeting with considerable favor in the treatment of erythremia, was first advocated by Eppinger and Kloss[16] in 1918. Contrary to the effect of benzol, which is supposed to retard the formation of red cells, these authors believe that phenylhydrazine hydrochloride as well as toluylendiamin increases red cell destruction. They reported striking results in their cases, with a reduction of the count in 1 case from 9,080,000 reds, 8000 whites and 150 per cent hemoglobin before treatment to 3,800,000 reds, no statement as to leukocytes and 67 per cent hemoglobin after the course was stopped. As evidences of blood destruction were the existence of a slight icterus and an increased urobilin output. They used from 1 to 10 cc of a 1 to 5 per cent solution of the drug given hypodermically once daily at intervals of one to three or four days. Later they found that its administration by mouth was equally effective and recommended from 0.1 to 0.3 gm. daily.

It is interesting to note that in a case of polycythemia hypertonica of Gaisböck it had a striking effect in also reducing the blood-pressure. In 1 case the systolic pressure fell from 200 to 120.

This treatment was carried out in the last case of our series. The patient, a man, aged forty-six years, was under the care of Dr. T. R. Boggs in the private wards.[1] He was given 0.1 gm. of phenylhydrazine hydrochloride by mouth daily from January 7, 1924, to January 31, when it was discontinued. Daily counts were made. On January 7 his blood count showed 7,612,000 reds, 8000 whites and 145 per cent hemoglobin. For the first two days there was a curious rise in the red count to 10,816,000 on January 9, after which there was a steady fall, so that on January 31 the count showed 6,325,000 reds, 10,120 whites and 135 per cent hemoglobin. The fall in the count continued, however, even after withdrawal of the drug on that date, so that on February 14 it showed 3,300,000

[1] This case will shortly be reported in detail by Dr. Trevor Owen.

reds, 11,000 whites and 75 per cent hemoglobin. There was marked improvement in his general appearance and subjective feelings of fulness in the head, sense of tingling, numbness in the hands, etc., and he was discharged from the hospital on March 1.

It is interesting to note, however, that on May 28 he returned for observation with a recurrence of some of his subjective symptoms and high color and with fresh dilated capillaries on the face, one of which had spontaneously ruptured. His blood count showed a gradual return toward the previous picture: The reds were 6,000,000, whites 7800 and hemoglobin 105 per cent. Having been impressed with the improvement under the phenylhydrazine treatment, he was again given another course with a reduction of his red count and hemoglobin to normal.

One of my confrères, Dr. John L. Dorsey, informs me that he has met with most satisfactory results with this remedy in 2 cases in which he has used the drug for over a year. He has found that by giving a total of 0.5 gm. each month the red count and hemoglobin have been kept practically at the normal figure. He gives 0.1 gm. daily for five successive days every month. The patients observe that if they do not take the drug at regular intervals there will be a return of the unpleasant sensations of fulness and tingling in the fingers, which are promptly relieved by the administration of the remedy.

It would appear, therefore, that we now possess a remedy that seems harmless, is easily administered and one which gives great relief to the many unpleasant symptoms these patients suffer from. It is reasonable to suppose that the risk of the development of some of the complications, particularly those referable to the vascular system, may be definitely diminished, and that, in consequence, life may be materially prolonged.

One word of caution should be emphasized. In administering the drug for the first time in any case frequent counts should be made and the drug discontinued before the count actually reaches normal, as it exerts its effect for some time after its withdrawal and a considerable anemia may otherwise actually be produced.

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DISCUSSION.

Dr. Alfred Stengel: There is, of course, nothing that anyone need say by way of discussion of Dr. Futcher's paper, which has covered the symptomatology and what is known of the nature of this disease so admirably, but as he alluded to various symptoms, certain experiences of my own occurred to my mind. Some of these may have a practical value and I therefore wish to mention them.

In the first place, with regard to the appearance of the patient: In the main these patients will, of course, be recognized by physicians on their appearance. The confirmation of the diagnosis will be made upon blood examination and more careful clinical examination, but the physiognomy of the patient is what will attract attention and perhaps suggest the diagnosis in the beginning. Now it has happened to me that I have failed to diagnose a case of this sort for the reason that I was seeing the patient in a rather early stage of the disease, or at least in a stage of the disease when the changes in his physiognomy were not very marked in the rather poor light, and consequently I was quite unaware of the hypercyanosis which, in a better light, might have been apparent. It happened that the circumstances surrounding this examination were such that a blood count was not had and the splenic enlargement, if it was at all present, escaped observation. It never became marked. Subsequently the disease was recognized.

In the second place, while I quite fully confirm what Dr. Futcher has said regarding this cherry-red or rosy-red or red cyanosis type of color

which these patients present, some of them do not. I have in mind two very striking ones, in one of which the color had led to the diagnosis of argyria. There is in some of the cases a steel-blue color which Dr. Futcher mentioned that might easily enough lead to that mistake. Some other cases present appearances suggestive of hematochromatosis when the pigmentations Osler alluded to as coming in the later stages develop. The diagnosis made by inspection might be erroneous in these ways.

There are also a few things about the symptoms which struck me as being worthy of comment. In the first place, while one would expect with such an enormous number of red cells and some evidence as Dr. Futcher stated of hemolysis in some cases, it has struck me as a curious circumstance that I cannot recall a single case of evidence of hemolysis in a patient. I think I have seen 8 or 10 of these cases and not one showed the slightest evidence of an icteroid color and Dr. Futcher did not mention the occurrence of that symptom. Another curious circumstance about these patients is this: While it is quite commonly recognized that these patients show symptoms of hypertension and while there may be cerebral symptoms, symptoms suggestive of disturbance of circulation in the brain and cerebral vessels, in none of the cases I have seen (and I noticed, too, Dr. Futcher, made no mention of it), has there been any particular cardiac failure. It is hard to understand why with the undoubtedly greatly increased viscosity of the blood and the consequent increased cardiac strain such cases may go on for six or eight years without any evidences of cardiac weakness or failure. They do show evidences of profound fatigue and weakness, such as patients with hypertension, but without erythemia, show.

In 2 patients under my observation the outstanding symptom was conjunctival injection. One of these patients, a woman, had been under various ophthalmologists on account of the enormous injection of the conjunctiva and without any suspicion on anybody's part that there was an underlying condition of the blood. I am bound to say in regard to that patient's case that it occurred before Osler's original publication, so it is hardly to be held against the credit of the ophthalmologists or internists. Since then I have seen another case of this curious intense conjunctiva injection, which I think is a symptom well worth while noting for the practitioner who sees these cases first.

The fact, as already stated, that these patients sometimes have very high pressure has been noted repeatedly, but I think we must be careful not to assume that a high pressure in the case of erythemia is necessarily the result of it. Where we have a patient with some lesion of the lung by which anoxemia may be brought about there may be associated arteriosclerosis and high pressure may not be entirely due to the erythremia.

It makes me wonder whether the condition of the blood and increased quantity of blood noted by investigators, whether these two things are the cause of the increased pressure rather than some associated disease affecting the vascular apparatus.

Dr. G. E. de Schweinitz: It may be of some value to add briefly to this discussion, so well introduced by Dr. Futcher's able paper, a few words concerning the ocular manifestations of erythremia.

It is historically interesting to recall that "cyanosis of the retina" is a term introduced by Liebreich, sixty-one years ago, to describe a condition of the fundus which had previously been observed and illustrated by the late Dr. H. Knapp. This so-called cyanosis of the retina may occur, as is well known, in connection with congenital heart disease, with erythremia (chronic sphenomegalic polycythemia), and under the influence of certain poisons, for example, dinitrobenzol.

Omitting the toxic cases from consideration, the ophthalmoscopic appearances of the other two exhibit considerable similarity, although the conditions themselves are widely different. Conspicuous fundus lesions are very large, often tortuous, darkly engorged veins, arteries sometimes unaffected, sometimes slightly enlarged and carrying dark-colored blood; nerve-heads hyperemic, hazy, or edematous, the edema being so great in some cases that the appearance of papilledema is manifest; and sometimes retinal hemorrhages.

Holloway, after a careful study of the literature available at the time he wrote, in 1912, and from personal observation, concluded that the fundus picture of erythremia could not be positively differentiated from that produced by congenital heart disease, and this decision is, I think, correct.

As to the presence of retinal hemorrhages in the two conditions, there appears to be much confusion, and the published statements vary from those which declare that in erythremia retinal hemorrhages have not been recorded, to that, for example, of Foster Moore, who writes that they (hemorrhages) may be "very profuse," and that they are more "profuse" than in cyanosis of the retina due to congenital heart disease. He backs his statements with a photomicrograph of a section of an eye taken from a subject of erythremia which shows an enormous infiltration of the tissues (choroid) with blood.

Certainly in cases of congenital heart disease very extensive retinal hemorrhages have been observed, even hemorrhages into the vitreous, while usually the hemorrhages reported as visible in the eyegrounds of patients with erythremia have been small; witness the observations of W. C. Posey, Edward Jackson and Walter Parker.

The water color I exhibit depicts the ophthalmoscopic appearance of a patient with erythremia studied in Dr. Stengel's wards (duration of disease, seven years; chronic polycythemia and splenomegaly; red cells varied from 7,500,000 to 11,000,000). The dark-colored fundus, the greatly enlarged purplish-colored veins (arteries practically unchanged), and the over-red nerve-head present a striking picture, which is probably the one most often visible in erythremia, although disc-edema or hemorrhages may be also present in some cases as has been stated.

What ought to be done to decide these points more exactly should be examination of the fundus in the two conditions by means of red-free light ophthalmoscopy, and also with the aid of the Gullstrand lamp and a contact glass. It must be, of course, remembered that gross changes in both conditions may be delayed, and hence the value of Jackson's record, as he had his patient under observation for some years. His illustrations closely resemble the one I exhibit, except the disc was not congested, and a few small hemorrhages ultimately appeared.

Although not exactly germane to the subject of Dr. Futcher's paper, it may interest the clinicians present to know that ophthalmoscopic examination has been utilized in cases of cyanosis retinæ from congenital heart disease in an endeavor to determine the character of the cardiac lesion. Thus, Nagel maintains that if both arteries and veins are enlarged, that is, darker and broader than normal, a communication between the two sides of the heart may be inferred; whereas, if the veins are large, very dark and tortuous, but the arteries unchanged, the lesion is one which does not permit the admixture of venous and arterial blood.

Dr. James M. Anders: The splendid paper read by Dr. Futcher and the interesting discussion by Dr. Stengel and Dr. de Schweinitz scarcely leave room for further remarks, but I would like to call brief attention to the fact that about fifteen, possibly seventeen, years ago I read a short paper before the College on this same subject, analyzing 18 cases, 2 of which had fallen under my own observation. At that time I recall seeing a statement by Dr. Osler to the effect that in his opinion the cause was increased erythroblastic activity of the bone-marrow and that happens to be the prevailing view as to the nature of the condition at the present day, according to Dr. Futcher. I think this is quite a compliment to one who originally described fully this interesting affection to Dr. Osler. There is another leading theory, however, and I would like to know whether Dr. Futcher thinks it is worthy of further consideration: It is that the oxygen-carrying power of the blood is diminished in this affection and that this deficiency is made up by an increase in the number of red cells. In my series of 18 cases, females predominated, notwith-

standing the fact that the majority of authors believe that the male sex is the more commonly affected. About 45 per cent of my cases showed albuminuria; a few tube-casts were noted in some of these as well as an increased blood-pressure. Dr. Futcher stated that in some cases the diagnosis of chronic nephritis had been made. Now I feel that in one of my cases it was perfectly justifiable to make this diagnosis of associated chronic nephritis because of changes in the arteries and high blood-pressure and urinary findings. I think it is the belief of not a few writers on the subject that chronic nephritis is not infrequently found in association with polycythemia vera. The nervous manifestations are definite and constant and were present in my cases. In one case a very painful form of mental apprehension, which I have rarely seen under other circumstances, was present. Certain writers on the subject have referred to this symptom and I would like to know if Dr. Futcher has noticed this in any of his series of cases. The treatment approved at the present day, to be very brief, is, I believe, venesection plus the *x*-ray treatment of the long bones, as first pointed out by Dr. Stengel. I believe this combined method promises the best results. In one case in my series the use of quinine in large doses had a most favorable influence according to the recorder; there was a distinct history of malaria. It is possible that this remedy is worth remembering in similar cases.

Dr. Futcher (closing): My experience is in accord with that of Dr. Stengel with regard to the absence of icterus. It was not noted in any one of our series, and I think I can also state that our experience is in agreement with his in reference to the usual absence of serious myocardial manifestations in this group of cases, notwithstanding the fact that many of them have had high blood-pressure.

I am very much interested in Dr. de Schweinitz's description of the fundi. Any clinician accustomed to using the ophthalmoscope will at once recognize the striking change in the fundi of these cases, manifested by the remarkable injection of the whole retina, with the striking engorgement of the veins.

With reference to the kidneys, I do not think there is any question but what there is often an associated chronic nephritis. All of our cases showed albuminuria and a large proportion showed casts. I think there is no question but what there is often some damage to the kidneys in these patients. The point I wish to emphasize is that many of the cases come into hospitals diagnosed as nephritis, the true nature of the condition not being recognized.

I am cognizant of the fact that the theory has been advanced that in erythremia there is overstimulation of the bone-marrow as a result of

insufficient oxygen-carrying power on the part of the red blood cells. I think the prevailing view at the present time is that, whatever the exciting factor may be, the true cause of erythremia is a hyperplasia of the erythroblastic bone-marrow analogous to what we find in myelogenous leukemia.

A word in regard to treatment. When a case of erythremia comes under your observation, I would advise you to give the phenylhydrazine hydrochloride a trial. I have not seen any reports of its use in this country. Dr. Owens obtained excellent results in the case he treated in our private wards. The red count returned to normal once there was very marked relief from subjective symptoms. I have personal knowledge of 4 other cases that have been controlled now for a year by this drug—2 by Dr. Sydney R. Miller and 2 by Dr. John Dorsey, of Baltimore. A total of 0.5 gm. each month holds the disease in abeyance. There have been no ill-effects. In commencing the treatment, one gives 0.1 gm. in capsules by mouth daily. One must discontinue the drug before the count reaches normal, for its effect continues for some days after its withdrawal.

THE CARE OF THE CONVALESCENT.[1]

By JAMES C. WILSON, A.M., M.D.

I.

The title of this communication, after a long period of comparative neglect, is assuming a new and very important significance. The researches of John Bryant[2] have shown that the care of the convalescent was recognized as a cardinal element of practical medicine among the ancients. Paris as early as the middle of the seventeenth century devoted nearly one-third of its hospital beds to convalescent patients, the Hotel Dieu and the Charité maintaining distinct sections for this purpose. In the early part of the following century special departments of the large English hospitals were allotted to the care of convalescents, and it is a matter of record that in 1858, Paris, by a special edict, further provided a thousand beds beyond the city limits for hospital patients convalescent from acute illness.

In our country the recognition of this particular need of systematic charity was more tardy. Boston during the last half century, from time to time established small out-of-town institutions for the care of convalescents, some of them as private charities, others in connection with the hospitals of the city. The Philadelphia hospitals early fell in line with suburban branches of a similar character, notably the West Philadelphia Department of the Pennsylvania Hospital, the Children's and the Rush Hospitals. These branch institutions, though partaking of the spirit

[1] Read October 23, 1924.
[2] Boston Medical and Surgical Journal, November, 1923.

of convalescent homes, are of a wider scope and use has been made of them for the patients generally for change of air and location during the hot season of the year. Ivycroft, the generous gift of Alba Johnson to the trustees of the Jefferson Hospital, stands out prominently among our charities as an all-the-year-round special hospital branch for convalescent patients. Similar small institutions have been established in the neighborhood of many other large cities, among which may be particularly mentioned New York, Cleveland, Baltimore and Pittsburgh. These small homes in any community, indicating as they do a growing recognition of a most important requirement in organized charity and having a number of beds which in the aggregate would be sufficient for the purposes of a working unit, fall far short of their original purpose. Their obvious defects consist in the disproportion between the overhead expenses and the number of beneficiaries; the greater cost of upkeep of limited accommodations as compared with those of adequate capacity; the necessary lack of a proper classification of cases; the insufficiency of appliances for the treatment of varying medical and surgical disorders, and particularly in emergencies and accidents; and the impracticability of providing in a small and constantly changing company the occupations, amusements and hope-inspiring social life and companionship which are essential measures of treatment among convalescents. An outstanding difficulty relates to the management. In a single person the knowledge, experience and personal gifts for the work are sometimes thrown away in a field so limited. Experience has clearly shown that small homes are not always attractive to the very convalescents for whom they were designed, and that great care must be exercised to guard them against the danger of becoming the more or less permanent abode of aged or hopelessly incurable persons.

Nevertheless, the proper care of the convalescent continued to be a neglected subject. Hospitals were built with public and private funds; dispensaries for general and special work of all kinds multiplied; Jenner had discovered vaccination; Pasteur had

turned the light of science upon the causes of disease and Preventive Medicine came into existence; but the patient who got over his sickness, but could not get well, was overlooked. Now and then a paper about him appeared in some medical journal, but they were few and aroused little interest. A great figure in the medicine of the past, he was almost lost sight of in the restless activity of the present. Then, in the early years of this century, two things happened which brought him again into the foreground —The World War and the Burke Foundation of a hospital of three hundred beds at White Plains, N. Y. The convalescent then reappeared; this time as a soldier and a citizen.

As a soldier, subject to discipline, untroubled by anxieties save as regarded regaining his health, cared for under the close observation of medical officers trained to their work, he realized in his own person and demonstrated to those having him in charge the value of the arrangements in the Convalescent Camp for work, play, rest, recreation and amusement, and the psychological factor in hastening his recovery. Thayer, as Chief Medical Consultant in the A. E. F., reporting in 1919, emphasized the fact that war statistics in regard to the duration of convalescence have shown the need of convalescent departments in connection with large hospitals, in which may be carried out every arrangement for the well-considered rehabilitation, mental and physical, of the convalescent patient. Bridgman, working in the same field in France, found that "the average patient, who has been sufficiently ill to require the average length of stay of three weeks in an acute hospital, has also been sufficiently ill to require an additional average period of three weeks under observation in a convalescent camp or hospital before he can be safely discharged with any assurance that he will be able to successfully hold down the job for which he has been prepared both mentally and physically during the period of his convalescent care."

As a citizen, the convalescent found in the hospital of the Burke Foundation, under the masterful care of its director, Dr. Frederic Brush, that arrangement of the measures for rehabilitation alike

of his bodily and mental disorders which were proving so useful in military life, but wisely modified and adapted to the civic temperament. Instead of the rigid discipline necessary to the camp, he found the plastic self-control of the school; instead of obeying orders he received instruction; instead of looking forward to a return to the front he was counting the days until he might return to his home and his job. In a word, his motive for the daily routine was not compulsion but a well-regulated habitual impulsion. But the result was the same. He got better in mind and body, and the "care of the convalescent" recovered its ancient place in our art—this time as an important part in Preventive Medicine.

The reaction to these facts was prompt and widespread. A convalescent department at the Walter Reed General Hospital was organized, and the principles of physical and mental reconstruction were followed generally in the Veteran Hospitals. Medical officers familiar with the army work in camp continued it after the armistice, and patients and the men who cared for them were alive to the opportunities afforded and the success which followed.

In civil life the operation of the Burke Foundation aroused even greater interest. There is no means of knowing how many convalescent homes were in existence in 1915, when the hospital was opened, but in a paper entitled "Convalescent Care in Suburban Communities," read at New Rochelle, N. Y.,[1] January 8, 1923, Brush has given a summary of the National Directory of Convalescent Homes, which shows in twenty-three states 162, with a total number of 8980 beds, 4455 available all the year round and 4525 in the summer only. Of these, 7270 are in fourteen states east of Ohio, and 1710 in nine states west. With its 300 beds the Burke Foundation has cared for approximately 35,000 patients since it first welcomed the convalescent poor of New York City.

The literature upon the subject rapidly increased. From an occasional paper upon some phase of convalescence, appearing

[1] The Nation's Health, April, 1923.

at long intervals and failing to call forth comment, during the period from 1900 to 1911, the year in which Brown's "Burke Foundation Report upon Convalescent Homes" was issued, there were only seven journal publications which Bryant considered of sufficient importance to refer to. During the following period, from 1911 to 1920, there were no less than nineteen, and to this number is to be added McKenzie's admirable little book, *Redeeming the Maimed*. This group includes the authorative papers of Thayer, Sturgis, Brush and Bridgman, which no student of the subject can afford to overlook. Since 1920 many papers have appeared, showing a wide interest in the subject and giving the results of its continued intensive study. Among these are to be especially named: "The Convalescent Field—Its New and Changing Border Lines;"[1] "Occupational Therapy for Men in the Convalescent Period;"[2] Health and Industrial Problems in Heart Disease in Middle Life,"[3] by Brush; "Placing Cardiac Patients in Regular Industries,[4] by Mrs. John S. Sheppard; "Study of Country Convalescent Treatment of One Hundred Neuropsychiatric Patients at the Burke Foundation and the Gould Farm at Great Barrington,"[5] by N. F. Cummings; and the little volume on "Nervous and Mental Reëducation," by Franz. To this list I must add the valuable report of Billikopf and Rubinow upon the "Problem of Convalescence in Relation to the Health Program of the Jewish Community of Philadelphia," dated April 1, 1924, but not yet published; and I cannot go further without emphasizing the great value, from every point of view, of the series of papers by Dr. John Bryant which appeared in the *Boston Medical and Surgical Journal* in 1922–23.

The importance of the subject justifies my having drawn freely from the foregoing publications and I hereby express my general acknowledgment and thanks.

[1] Modern Hospital, June, 1916, reprinted in Boston Med. and Surg. Jour., April 1923.
[2] Archives of Occupational Therapy, April, 1923, vol. ii, No. 2.
[3] The Nation's Health, April, 1923, issue, vol. v, No. 4.
[4] Journal of Industrial Hygiene, March, 1924, v, No. 6, 189–204.
[5] Read at Annual Meeting of Am. Assn. Hospital Social Workers, May, 1923.

II.

Convalescence is the gradual recovery from illness, injury, a surgical operation or prolonged mental or physical overfatigue. Each of these occurrences constitutes a trauma which, when severe, involves both body and mind and long outlasts its immediate cause. The disease has run its course; the wound has healed; the rest has done him good, but the patient is not yet well. His physical disability prevents him from going to work; his muscles have lost their tone, his hands their cunning. Somebody else has got his job. Even the doctors are no longer interested in him. He is not wanted in the ward and he knows it. Not only that, but he is not always sure that, in his present condition, he is wanted at home. Perhaps he has not any home to go to. Too often he drifts into a state of fault-finding credulity which renders him abnormally susceptible to suggestion.

These are the persons upon whom the cults and isms thrive; who have the dispensary habit and too often come at last into the state asylums. These are the persons to whom, on the other hand, the well-organized convalescent hospital reaches out its help. To take them when the illness has run its course; when the effects of the injury are subsiding; when the wounds made by the surgeon's knife are healing; when the repose and quiet of the ward have begun their work of repair, at the *end of the sickness* and the *beginning of convalescence*, and to give them occupation, play, recreation and amusement, comfort, peace and hope, is the new Care of the Convalescent.

I do not ask, Can there be a finer charity? It is no better than the hospital for acute disease; or the dispensary for the ailing poor; or the sanatorium for the tuberculous; or the maternity; or state institutions for the care of those who cannot help themselves; but it is in itself as fine as any of these and finer than them all, because it rounds out and completes the cycle of our modern organized charity. It is the last factor in Preventive Medicine. In thus serving the individual it renders an even greater service to the

community, since for every convalescent thus helped a bed in the acute hospital is released to the urgent needs of another acute case. Furthermore, it relieves the members of the staff of the acute hospital of the responsibility of caring for patients for whom their proper work gives little time, and who in fact require the services of physicians of a different training and experience. The right use of well-organized convalescent hospitals not only diminishes but even does away to a large extent with a condition described as clinical neglect.

Medical education, as the curriculum is now arranged, is on the clinical side chiefly occupied with the urgent and obvious. The teaching of the history of disease concerns itself so fully with causation, present condition, course and termination, that it gives little heed to the insidious and vague derangements of health which, starting in well-defined illness or injury, tend to persist as chronic invalidism. As this truth comes to be more widely understood, and the importance and requirements of convalescence more generally appreciated, medical men, recognizing it as a branch of preventive medicine, will train themselves for it as for any other specialty.

By far the greater number of convalescents must be treated at their homes, and it is here that the family physician finds a field of usefulness not sufficiently understood and cultivated. Where home convalescence is available there are certain advantages. Even "going home," where it is practicable, has a restorative influence. For the milder cases, with the right kind of follow-up service, it suffices. The home is often not what it ought to be, but it is thus kept together and bettered by new and educational influences. But for the minority, all too numerous, for whom the home is not available or who must have treatment and a mode of living which the home cannot provide, what is to be done? It is no longer a question of admitting, treating and discharging patients. This is the plan, these are the functions, of the acute hospital, and the scale and effectiveness with which they are carried out constitute one of the glories of our civilization. But the patients are human beings and convalescence is too often beyond

the scope of the best-equipped hospital. Where the means are available the country branch may meet the requirements; but it must be established upon a large scale, suitably located within easy access of the main institution and prepared to meet every reasonable need of a diversified company of inmates. The general opinion of those who have had experience in the matter of branch convalescent homes is that their medical organization should be separate from and independent of the staff of the main institution. It goes, however, without saying that harmonious coöperation is essential and that occasion as relapse, any acute illness or accident making it necessary, inmates of the convalescent branch may be returned to the main institution. Such branches would correspond to the Burke Foundation and have frequently been proposed and discussed. But the munificence which brought that splendid institution into existence is rare; not only so, but the great importance of the widening field of convalescence is so little understood that the disposition of charitably disposed persons of relatively large fortune still inclines to the endowment of the hospital rather than the convalescent home.

The Dunwoody Home for Convalescents, just completed, with a capacity of 37 beds, well situated about thirteen miles from the City Hall, is at once a lasting memorial to the founder whose name it bears, a noble charity to the poor of a wide district including Philadelphia and a sign that this form of beneficence is becoming more clearly understood. The terms of the bequest delayed the erection of the building until a sufficient fund for that purpose was accumulated from the interest, the principal remaining intact for maintenance.

Anna Magee, the last of her immediate family, has left a large bequest "to commemorate her name by rendering lasting service to the poor and increasing the usefulness of the hospitals in her native city, Philadelphia." To accomplish this purpose she has expressed the desire to found and endow an institution to be called the "Magee Memorial Hospital for Convalescents." Her will is very explicit as to the organization and management of the institution, and the wording of the codicil, dated February, 1917, bear-

ing upon this bequest is very remarkable, since at that time neither she nor the friend with whom she took counsel concerning it had any knowledge of the Burke Foundation. It is to be hoped that the trustees of her estate will not be prevented by the requirements of the law from allowing the interest of the principal sum, together with the reversion of various life interests, to accumulate until a sufficient amount to fully carry out the wishes of the testatrix has been reached.

III.

Who compose the suitable cases for institutional convalescence? The time is past for the restriction of the field to patients who are likely in a brief period to regain their health. Such acute medical and surgical cases, transferred from the hospital or their homes, upon the subsidence of the active symptoms are soon ready and glad to return to their usual life and occupation. The convalescent home has tided them over the dangers of relapse, enforced idleness and discouragement. But its present-day scope goes far beyond this group. It includes protracted illness of many kinds. Brush states that in the Burke Foundation the list of diagnoses for a year of six thousand admissions included about all the terms in medicine. It is fitted to care for postoperative and other surgical cases still requiring dressing, wounds with drainage, empyemata, mastoid cases and the like, the later stages of fractures and dislocations, and the results are satisfactory. Transportation by motor ambulance meets the requirements of recent surgery. Wounds heal more rapidly in the country air. The coöperation of the surgeon is available by means of the telephone, by correspondence and visits.

In cardiac cases the usefulness of the convalescent home is paramount. Its influence is to resist the beginning of trouble, to minimize the early damage. Childhood and adolescence are the periods of the greatest danger in neglect and the greatest usefulness in treatment. But it is in the interest of economy and good management that the age of admission in the general convalescent

home should not be below fifteen years. No patient who has reached that age, and who on account of other conditions requires convalescent treatment, should be refused admission on account of a murmur or a diagnosis of heart disease. In fact, the signs of cardiac disease in persons of failing health and want of strength for the daily work, in the absence of other obvious cause, are urgent indications for convalescent treatment. A few weeks in the country home, from time to time, may often be counted upon to prolong a handicapped productive life. Those who fail to respond are held to a fair trial only and discharged as unsuited to the methods. Cases of recent severe heart disease, because of the liability to relapse, must be treated in the hospital or the home until convalescence is well advanced.

Rheumatism in its acute forms must, from the standpoint of admission, be classed with cardiac disease, with which it is so frequently associated, and this is also true of the convalescence from other acute infections of early life.

Forms of tuberculosis involving bones, joints, the kidneys and viscera other than the lungs are not always to be refused, and quiescent cases of pulmonary tuberculosis from sanatoria may be taken with due precautions, for short periods, pending some suitable permanent arrangement elsewhere.

Borderline mental cases constitute a grave problem. A large proportion of persons convalescent from acute illness are to some extent mentally let down. It is the work of the convalescent home to pick them up, and this it is in most cases abundantly able to do. Experience must determine how far the general home can do for others, if at all. It will probably be found better for existing institutions for mental cases to extend their efforts in the direction of prolonged convalescence.

There is another group of persons, and this is the largest of all to whom the Convalescent Home is most useful—men and women literally worn out in the struggle for existence. Here are found those who have lost their means and those who have never known anything else but poverty; those who have been able to do the daily task, but find it not only less remunerative but are also

painfully conscious of their progressive inability to perform it; the constitutionally inferior and the habitually discouraged. A little time of rest and peace in a country home, with prescribed repose, limited occupation and physical upbuilding, often means for a while a fresh start in life. The list is too long. We see these people at every turn. It is only a little more and they are positively ill and often hopelessly so. To avert the catastrophe is the work of what has been called preventive convalescence.

Serious chronic conditions are no longer a bar to admission. With a limit of stay agreed upon many such patients may be much helped; some unexpectedly regain a fair degree of health. It is a chance worth taking. In this connection I quote Mrs. Sheppard:[1] "From the establishment of the Employment Bureau for the Handicapped, in April, 1918, up to November 1, 1922, 5304 persons have been placed. Of this number 1039 were cardiac patients. To put this number of handicapped persons into regular industry is a valuable contribution to the community; and the fact that the wages of handicapped persons placed by the Bureau in one month amounted to $11,657.60, while the cost of running the Bureau for that same month was less than $500, shows that the work is distinctly valuable on the financial side, as well as on the broader basis of value to the man himself in assisting him to become self-supporting and to take his place again in the life of the community." It is these handicapped persons to whom in time of physical stress the hospital for convalescents gives the ability to go to work again.

Indefinite as the borderlines are, they must be drawn. Those suffering from active pulmonary tuberculosis or other communicable disease; diphtheria and typhoid fever carriers; chronic organic disease in the later stages; inoperable, visceral or metastatic cancer cannot be received. There are many others. The list includes pronounced nervous and mental disorders, various dyscrasias and conditions objectionable to the members of the convalescent community.

[1] Journal of Industrial Hygiene, March, 1924, v, 189–204.

Nor can age determine the question of eligibility. Men and women beginning to feel the weight of years may be much helped by preventive convalescence for a time and again. But the physiologically aged cannot be admitted. Theirs is a malady without convalescence. It is, however, a question of tissues not of years.

Sex has to be considered. The small convalescent homes are necessarily exclusive: Some for women; others for men. At the Burke Foundation, which is the model upon which the large institutions will be founded, persons of both sexes are freely admitted. With the younger patients there is sometimes trouble, just as in collegiate coeducation; but it can be averted. Upon this subject I quote Brush at length: "It may be stated that sex difficulties are minor and easily administered; that the by-play of sex association is definitely convalescent (based upon the psychology of desire of each to appear strong, good-looking and competent to the other); that boys and girls are not deteriorated by convalescent residence with adults, but that each tends to raise the tone in the other age-groups. Men and women meet all day in the central court, in all assemblies, dances, etc., in group play and in occupation. A great deal of the best recreational therapy is impossible without this mixing, which simulates everyday life for which all are preparing, but no attempt at home conditions is made, the whole plan being based upon a frank institutionalism."

IV.

Time forbids my going into the particulars of therapeutics. The scheme has been suggested in the foregoing remarks. Drugs scarcely enter into it. For the majority of the patients nothing else equals the restorative effects of a well-planned vacation with freedom from money worry. Every convalescent is made a special study. A vast amount of detail is involved in the organization and the list of publications of the Burke Foundation can be had for the asking. Leadership is essential and it is manifest at every point. Without the gifts of the director the Foundation would

have been slow in coming to its present usefulness. That spirit of leadership pervades the medical staff, the nursing body—there are no pupil nurses—those who arrange the work and direct the recreation; and it is that spirit which, spreading through every department, enables the occasional patient who so desires to cast his or her lot with the Foundation and pass up from the list of patients into the regular force.

To every new plan there are objectors. Two objections are still occasionally urged against the country home: (1) The convalescent does not want to go to it, and (2) that when there he does not want to leave it and his friends refuse to take him away.

To the first of these the reply is to be found in Health Education. This is a school in which there are several classes and there should be no vacation. The care of the convalescent is an important lesson for the nurse training-school, the medical social-service, the resident physician, even the physician or surgeon-in-charge may quietly let drop a telling word at the right time. The most impressive lesson is that which those who have been out there have to tell. Under these influences the patient usually begins to think of a few weeks in a country home as worth while. It is an old story that the wrong ones want to go and the right ones must be persuaded to go. If there are sick benefits, there will be less trouble about them in the country institution than if the convalescent has returned to or remains in his own home while able to go about though not yet able to work.

The reply to the second objection is that the most will want to leave too soon. These must be taught to remain until the convalescence is complete. But for the others the solution of the problem depends upon the regulations for admission. These must be under the control of a single admission officer backed by the full authority of the institution and they must be firmly adhered to. The sending organization or person must agree beforehand, in writing, to take back the convalescent patient when discharged and restore him to his home or place him in a suitable institution. The occasional efforts of private physicians, friends or *others having influence* make it necessary, in the matter of admission, to deal

with the acute hospital, the medical social-service or some other responsible organization. Inadmissible applicants cause much trouble, expense and sometimes suffering. Those only who are suitable should be proposed. The length of stay varies from one to several weeks and is determined for the individual by the medical officer in charge of the institution. When by mischance a doubtful case is received arrangements for discharge are begun at once and an early date set.

To meet these requirements a city admitting office, centrally located, in charge of a supervisor of proven medical-social ability and experience, is necessary. The large convalescent home can well afford the expense of maintaining it and welcome the small outlying home to make use of it. In the absence of a greater institution, as is the case with Philadelphia at present, the coördination of the smaller ones, of which there are some thirteen or fourteen, may be effective—some limited to groups of similar cases, the classification being by medical diagnosis. Under such circumstances the support of the admitting office must come from the charitably disposed who realize the importance of the welfare work, of which a clearing house of this kind forms an essential part. To establish and endow it would be a broadminded gift to organized charity. The authoritative decision between right and wrong applicants means the difference between success and failure. Vacancies and the fitness of applicants may be determined by telephone. The most urgent, needy and likely to regain health are to be first chosen. Waiting lists should be so far as possible avoided and the disappointment of ineligibles minimized. This is largely the function of the medical social-service workers. Applications are to be made by cards supplied to hospitals, institutions and physicians, or directly in person. Lunches are served to those accepted and transportation to the home is by automobile. There are no charges whatever attending the application or transportation. In addition to the routine of selecting the patients and assisting those who return to secure suitable occupation, the City House keeps records of the names and addresses of convalescents and applicants and arranges follow-up medical social service,

provides rooms for the meetings of health and civic organizations, committee meetings and other informal gatherings of like kind.

Such is the plan of the Burke Foundation. The Jews of this city, who administer their charities in accordance with the best business principles, have established a commodious clearing house of this kind, at Ninth and Pine Streets, to be used for welfare purposes. This movement clearly looks forward to the enlargement of the convalescent homes at Torresdale and Atlantic City and their reorganization in accordance with the requirements of present-day needs. The existence of this central office is a constant reminder of the purposes of their Welfare Federation and a manifest recognition of the importance of caring for the convalescent in a well-organized and practical way.

V.

All this means a great investment of money. The endowment of the Burke Foundation is about $4,000,000, producing an income of approximately $210,000 yearly. The buildings and grounds cost about $1,700,000. This takes care of about 6000 patients a year. But it takes care of them in the right place and in the right way. It is revolutionizing the care of the sick poor, by showing that while hospital costs are variously estimated at $3.00 to $5.00 a day, country convalescence is $1.50, home care $0.50, and that handicapped labor can be made to a large extent self-supporting. Planned as a year-round institution, it has demonstrated the fact the results are almost as good in the winter months as in the summer and that vacation homes in the United States containing about 4525 beds, unused during nine months of every year and subject to the expense of closing up and opening and reorganizing the service, mean an enormous waste of money. The admirable little convalescent hospital for children at Broomall, used three months as a holiday home for five years, has recently been made a year-round institution with 27 beds. Billikopf and Rubinow, in the report above referred to, suggest that the Jewish Seaside Home at

Atlantic City, which at present operates only ten weeks throughout the year, could better fulfil its function as a home for invalids and extend its usefulness if it were open all the year round, and that after the larger program for a modern convalescent home in the neighborhood of the city has been realized the seaside home should be used for the assignment of special cases when necessary.

The realization of this larger program is what we stand in need of. The time is ripe for action. Whether the solution shall be action on the part of the Jewish community, of the municipality, or of some private benefactor or association of benefactors of great wealth, remains to be seen. Let us hope that it will be all three independently, but working in harmonious coöperation and including in their respective organizations the smaller homes now existent or in planning. Three such great institutions will be none too many for a growing population of nearly two millions.

In theory the Convalescent Hospital should be a free institution from the beginning. There should be no pay patients. A money gift from the interested acute hospital, the insurance company, the corporate or individual employer, charitably disposed persons, friends or relations, even the patient himself, will be gladly received as a contribution to the general fund, but cannot be accepted for the board or services rendered an individual patient or a group of patients. The reasons are obvious: If some patients are free and others pay, or some pay more than others, groups are formed, envy and jealousy are fostered, discipline is impaired, the beneficial social life is unfavorably affected. Even a small payment is deterrent. Ivycroft, operated for some years at a charge of $7.00 a week, received very few suitable applicants. Recently it was made a free institution and has since been filled to capacity. From the first the Burke Foundation has been a free charity and could well afford to be so. As I write these lines, I learn from Dr. Brush that "The present-day income is proving inadequate to maintain the work as now conducted and provide a fund for future-plan buildings and needed extensions of service. This has led us recently to begin with fair success a part-pay scheme in our present home, and we may, after experiment, extend the pay method." Why,

when doing such splendid work on a sure financial basis, plan future buildings and extensions of service?

There are, and there should be, pay convalescent homes for those who can afford to use them; but the convalescent home for the poor of a city should serve its beneficiaries without money and without price. It should be absolutely free. The freedom, however, must be guarded from abuse. Neither those who are hopelessly incurable, nor those who for a time are merely unwilling to take care of themselves, can be received.

In conclusion, I cannot refrain from reading a paragraph from a paper written by one of the trustees of the great convalescent hospital at White Plains. His enthusiasm is infectious. Writing about the restorative and upbuilding influence of a scientifically planned vacation, Mr. Sturgis says: "Taking then the most effective restorative agency known, the Foundation adapts it to the half-sick, the handicapped and subnormal, the failing, the depressed. The patient goes under the expert in vacationing—*conditioning for daily life*. Sleep, exercise, rest, feeding, amusements, diversional and hardening occupations, companionships, care of minor ills, dentistry, mental and moral slants, home betterments at the same time and future employment are all studied and adjusted to the individual, and the results are inevitably and inspiringly good. A successful convalescence sends the person away with the glowing eye of the ten-year old, 'the Burke Foundation Eye' the social workers have come to call ours; or 'the Burke Foundation Face'—smoothed, smiling, courageous."

SPOROTRICHOSIS: REPORT OF A CASE FROM PENNSYLVANIA[1]

By FRANK C. KNOWLES, M.D., EDWARD F. CORSON, M.D.
AND
HENRY B. DECKER, M.D.

(From the Dermatological Department of the Jefferson Medical College)

The first case of this disease came under the observation of Finney and Schenck, in Baltimore, in 1896, and the latter isolated a fungus from the lesions by culture. This fungus was classified by E. F. Smith as of the genus Sporotrichum. The findings in this case were published in 1898.

In 1903 de Beurmann and Raymond recognized the first case of sporotrichosis in France and the organism isolated was studied by Matruchot and Raymond. These investigators named the fungus in 1905 the Sporotrichum beurmanni.

R. L. Sutton, of Missouri, and Trimble and Shaw, of Kansas, are credited for the local interest aroused in this disease, which resulted in the recording of 39 cases, 21 of them proved by culture, in their section of the country, from 1910 to 1912.

The thorough investigations of de Beurmann and Gougerot were responsible for the hundreds of cases recorded in France, and to them we owe most of our knowledge of this disease.

Sporotrichosis is of world-wide distribution, having been reported as present in Europe, the Americas, Asia and Oceanica.

Meyer tabulated in May, 1915, 82 cases reported in the United States; 50 of these were diagnosed by culture tests.

Foerster has made a valuable contribution to this subject during

[1] Read November 5, 1924.

the present year and his statistics will be largely used in the present contribution.

There have been 125 cases of Sporotrichosis reported in the United States, in 66 of which the causal organism was isolated; 94 of these occurred in the Middle West. Very few cases have been recorded in the Eastern United States, England and Germany.

The occupation of 70 adults was mentioned; there were 20 farmers and farm laborers, 16 industrial workers, 18 housewives and servants, 5 gardeners, 3 florists, 2 clerks and 1 each of the following: Soldier, sailor, merchant, teacher and shop superintendent.

The average age of 100 cases was twenty-nine years, 71 having occurred between the ages of sixteen and fifty. The oldest was seventy-seven years, the youngest sixteen months; 20 were children. There were 67 males and 33 females.

The site of the primary lesion was given in 109 cases as follows: Thumb, 9; index finger, 13; other fingers, 11; back of the hand, 17; hand, 8; palm,4; wrist, 10; forearm, 10; arm, 2; elbow, 3; shoulder, 2; neck, 2; cheek, 1; toe, 2; leg, 9; eyelid, 5.

Skin injuries were mentioned as predisposing factors in 43 cases.

The location of the primary lesion was on the hand or finger, most frequently the right, in 62 cases and on some part of the upper extremity in 90 of 109 cases.

Gougerot recognizes the following clinical varieties:

1. Multiple disseminated subcutaneous gummous sporotrichosis.
2. Multiple ulcerating gummous sporotrichosis.
3. Localized lymphangitic sporotrichosis.
4. Sporotrichosis dermique.
5. Sporotrichosis epidermique.
6. Extracutaneous sporotrichosis.

The first variety, multiple disseminated subcutaneous gummous sporotrichosis, is the type most frequently observed in France.

The third variety, localized lymphangitic sporotrichosis, is the predominating type observed in the United States.

It will prove illuminating to give Gougerot's description of the latter type usually observed in this country.

Localized Lymphangitic Sporotrichosis. This variety of the disease is the one most commonly met with and described in American literature. The first manifestation is the initial lesion or sporotrichotic chancre, occurring at the site of inoculation, where there is usually a break in the skin due to injury. A frequent site is the index finger, thumb or back of the hand. This lesion is sometimes a simple ulcer, an anceform pustule, an abscess, a gumma or frequently a vegetative plaque, becoming verrucous and having the appearance of a verrucous tuberculosis. Rarely this is the only lesion present. Usually, after a variable period of a few days to several weeks, multiple subcutaneous gummas appear along the course of lymphatic drainage from the site of inoculation, and with these there is also frequently an ascending lymphangitis resulting in a palpable, painless, cord-like thickening of the lymphatic vessels, which is sometimes very pronounced. The gummas usually behave in a similar manner to the lesions in the first variety of the disease, but frequently ulcerate spontaneously or after incision with the development of polymorphous lesions such as have just been described. The regional lymph nodes may enlarge, become indurated and occasionally suppurative. A pure culture of sporothrix has been obtained from a suppurative gland. The lymphatic variety remains a localized cutaneous and subcutaneous process, very rarely becoming disseminated through the blood vascular system to other parts of the body. The initial lesion may have healed, the disease showing only the localized gummous lymphangitis, or there may be no lymphangitis and the site of inoculation may show the only manifestation of the disease. The diagnosis is based on the aspect of the chancre, which at one time may be both vegetating and oozing, verrucous and dry, the rapid evolution of the lesions, the presence of microabscesses in the vegetations and of intradermic abscesses, the frequency of autoinoculation of the adjacent skin, the polymorphism of the gummas and their lymphatic distribution, the lymphatic cords, the lack of symptoms and finally the rapid response to potassium iodide.

Sporotrichosis may invade any or all tissue and organs of the

body and shows great clinical polymorphism. In certain cases of this disease there may be cutaneous, subcutaneous, osseous or visceral lesions in different stages of development.

Widal and André have isolated the parasite from the blood of a patient with cutaneous sporotrichosis (Adamson).

Adamson states that the mucous membranes may be involved and perhaps even pulmonary abscesses may be caused by the presence of sporotrichium.

The fungus grows on all sorts of soil and at a wide range of temperature.

According to Hyde and Davis the period of incubation of the disease in human subjects extends somewhat uniformly between the sixth and twelfth day, the most developing seven days after invasion.

The latter writers state that the lower animals to which the sporothrix has been successfully transmitted are gray and white rats and mice, dogs, guinea-pigs and fowls. The pigeon, the rabbit and the guinea-pig seem less suceptible than the others. They successfully transmitted the disease to a Rhesus monkey.

Meyer accidently inoculated his finger with laboratory material from an infected horse and sporotrichosis resulted. He states that similar cases resulted from the bite of a gopher, rats, parrot, hen, field mouse and white mouse. This investigator believes, however, that the wounds may have been secondarily inoculated by plant material containing the fungus.

The fungus of sporotrichosis shows pleomorphic characteristics which has led to a considerable amount of discussion as to whether the organism isolated by Schenck and the one found by de Beurmann were the same. The French believing them different while the majority of American investigators believe them to be the same. This, however, can be stated that their serological reactions and their pathological effect on certain animals is identical.

There have been but 6 cases of sporotrichosis observed in the state of Pennsylvania, in which the fungus has been cultured and isolated.

Meyer recorded 2 cases, Miller 1 and Guy 3 in the same family.

The seventh case is reported by us in the present communication:

Mrs. M. E. W., forty years of age, native American, housewife, came to the skin dispensary of the Jefferson Hospital May 14, 1924. During February, 1924 she abraded her right index finger against a stove; within twenty-four hours a papule, reddish and indurated, developed at the site of the abrasion. A few days later this lesion enlarged, softened, pointed and opened spontaneously. Two weeks afterward similar lesions developed along the forearm and later lesions appeared on the hand and arm. The lesions all followed the superficial lymphatic drainage of the index finger. They were incised, curetted and drained by other physicians, with no apparent relief.

Her personal and family history have no bearing on the condition.

Cultures showed the presence of the sporothrix.

She was placed on sodium iodide, gr. xv, t. i. d., which she could not tolerate. After a week she was given syrup of ferrous iodide, ♏ xx, t. i. d., which she has taken up to the present time.

The lesions are entirely healed after ten weeks of treatment.

Descriptions of Cultures and Fungus. Cultures were made from necrotic material in the lesions, on Sabouraud's maltose agar, inoculated and incubated at room temperature.

Colonies first appeared at the fifth day as minute whitish spots surrounded by a delicate whitish fringe. These rapidly increased in size, attaining a diameter of about 1 cm. by the tenth day. The center was elevated, the edge smooth and the surface white and glistening.

The colonies increased in size at a slower rate, and by the twentieth day, the color remaining the same, the edge had assumed a peculiar corrugated appearance.

By the fortieth day the growth covered the entire surface of the medium. It was brownish-gray in color, markedly wrinkled and somewhat dry and powdery.

Although numerous media were used, Sabouraud's maltose agar gave the most characteristic growth.

Hanging-drop preparation showed a mass of interlacing, branching, septate hyphæ. These were about 2 microns in diameter and varied considerable in length.

The spores were fairly numerous, spherical or oval in outline and slightly greater in diameter than the hyphæ (about 3 microns). They apparently arose from any portion of the hypha. No sterigmata were noted. At numerous branches the spores were noted in the angle formed by the branch.

The fungus grown from this case shows certain characteristics of the type described by de Beurmann, but we believe this is due to the fact that the primary inoculation was made on Sabouraud's proof medium.

We believe, however, that the fungus belongs to the variety originally described by Schenck, as this case clinically corresponds to the usual American type.

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DISCUSSION

Dr. Fred D. Weidman: In this excellent paper by Dr. Knowles he presents one of the few mycotic infections which may end fatally; blastomycosis, actinomycosis and sporotrichosis constituting the three most important. Thus, all of these diseases may become generalized and end fatally. In this splendid picture which Dr. Knowles has painted, he has treated the central figure so thoroughly that I would spoil it if I essayed to amplify it; accordingly I shall but touch the edges and perhaps spread out onto the frame a little as I attempt to discuss this paper.

In all diseases it is useful to know what the source of infection has been. Dr. Knowles has indicated that in many cases a wound has been the starting place; in some cases inflicted in the form of the bite of an

animal or insect, or as the result of traumatism, prick of a thorn, or something of that sort. I believe that the correct interpretation to be placed upon this is that of the predisposing cause of the affection. I do not believe by any means that the organism is in the beak of the fowl, tooth of the dog or cat, or present upon the horns of an animal at the time the injury is inflicted. Animals habitats such as these are unlikely for fungi. I do not know of any demonstration of this fungus in such animal parts, but the genus Sporotrichum has been demonstrated while certain investigators of disease in canned goods were studying the flora of dried vegetables. Thus, during a survey of canning factories, out of 360 different fungi isolated from dried vegetables a small proportion were of the genus Sporotrichum. This organism has also been isolated from decorative plants, such as the barberry. Thus we know positively, from bacterial trials, that this organism is present in vegetable matter, and it is my personal belief that in those cases where animal injuries precede a secondary contact with soil products is necessary.

To the dermatologists a case such as Dr. Knowles presented is absolutely typical. The multiple lesions passing in a direct straight line up the forearm along the course of a trunk of lymphatics are diagnostic; but the solitary lesion of sporotrichosis may cause a great deal of trouble. One could easily see how such a subacute affection as sporotrichosis may produce a tissue change like that of the tubercle bacillus or blastomyces. In these cases there is only one way of establishing the final diagnosis, namely, to establish the presence of the microörganism. It is usually easy, but at times contaminating organisms make it difficult, and in case of failure agglutination tests are in order.

There are two or three technical wrinkles to be taken advantage of in demonstrating the organism in the face of these contaminating bacteria: (1) Let the material (pus) dry for two or three days to allow the contaminating organisms to die out. (2) Dr. David L. Farley has pointed out the use of the gentian violet as a restrainer. The ordinary cocci are, as you know, restrained in a concentration of 1 to 500,000; sporotrichum requires 1 to 1000. (3) When making diagnosis from the pus, if the worker has no facilities for culture he may detect the organism by direct examination. In this we must destroy the leukocytes, because the yeast cells look very much like the degenerate nuclei of leukocytes. This is done readily by heating the pus in 15 or 20 per cent of NaOH solution. (4) Animal tests is the court of final resort.

The last point which I wish to bring out can be done by lantern slides, and is to the effect that there are various species of sprotrichum and that all of the sporotrichums to be found in an ulcer are not pathogenic. (Dr. Weidman then showed lantern slides.) It does not suffice to simply recognize the genus of the organism; the species has also to be determined.

Dr. Edward F. Corson: When one occasionally encounters such a case as Dr. Knowles has detailed the inference might arise that numerous other such cases exist, but unrecognized, mistaken for the most part for bacterial invasion of the infected part. This inference, however, I believe to be wrong. The tenacity and the progress of this infection is such that without specific medication it would sooner or later arrive at the point where expert opinion would be required to establish the diagnosis. It is usually acknowledged that the practitioner here in the east is less ready to recognize sporotrichosis than his mid-western brother, who has been taught in recent years to look out for this condition as it is much more frequent in that region. However, I cannot explain the dearth of reports from this vicinity other than by infrequent incidence of the disease here. The recognition of this particular case should have been easy, but as a matter of fact the patient drifted from hospital to hospital and under the observation of numerous private physicians until the case finally arrived at the dermatological clinic. As a result of injudicious surgical intervention she received disfiguring scars extending from her index finger to the middle of her upper arm and suffered considerable inconvenience also as the result of incisions made at these different points. It is usually acknowledged that non-interference of surgical nature is much more desirable than drainage of these abscesses. This case was practically a typical one and yet went on without recognition for some twelve weeks. Of a certainty it is a rare disease in these parts, but of a like certainty we must occasionally expect to find it.

Dr. Henry B. Decker: This case was very interesting. The lesions were typical of the Sporotrichium schenkii infection. The organism had characteristics of both the Schenk and de Beurmann types.

We offer as an explanation the fact that the primary culture was made on maltose agar containing French peptone and maltose. The different cultural characteristics of the various pathogenic molds on media made with different peptones is well known. It has been demonstrated by Dr. Weidman.

We feel that the difference between these organisms is not so much in the organism as it is in the medium on which the organism is cultivated.

Dr. Knowles (closing): As this subject has been rather well covered in our paper and in Dr. Decker's discussion, there is nothing further for me to add.

THE CALCAREOUS DEPOSITS OF SO-CALLED CALCIFYING SUBACROMIAL BURSITIS[1]

By JOHN BERTON CARNETT, M.D.

I HAVE personally operated on 14 cases of the condition commonly called calcifying subacromial bursitis for the removal of calcareous deposits, and have assisted my former chief, Dr. Edward Martin, in operation on 5 other similar cases. I have seen more than 25 shoulders in which a calcareous deposit was demonstrated by the *x*-ray but in which no operation was performed. Many of the operative cases had bilateral deposits but had operation on only one shoulder.

Anyone attempting to familiarize himself with the literature dealing with these cases should read the papers of Codman, in which he describes subacromial bursitis as the most common cause of stiff and painful shoulders. I believe further investigation will demonstrate that a variety of lesions, of which calcareous deposit is one, may give rise to the symptom-complex now usually ascribed to subacromial bursitis. Codman's contributions are classics in dealing with the mechanism of normal shoulder movements. His observations are supplemented by those of Stevens, who has studied the action of the short rotators of the shoulder. Codman's clean-cut description of the symptoms of subacromial bursitis and the mechanism by which they are produced has been accepted without much alteration by subsequent writers. I endorse the majority of Codman's observations and will quote freely from them in this paper.

Calcareous deposits were unknown when Codman published his

[1] Read November 1, 1924.

first paper, in 1906, and he makes no mention of them in it. Painter, in 1907, was the first to report the finding of definite shadows in the shoulder by *x*-ray examination in 4 cases. He assumed that the shadows were caused by thickening of the walls of the subdeltoid bursa, as did Baer, who also reported 2 operative cases in 1907. In the light of our present knowledge there can be no doubt that both these authors were dealing with calcareous deposits. They each reported having excised the entire subdeltoid bursa in 4 cases. Painter found the deposit in two of the specimens removed at operation, but missed the deposit in the other two probably because he did not search for it underneath the floor of the bursa.

Painter and Baer reported the deposits as being located within the cavity or walls of the bursa itself, but Codman saw Painter operate on 1 of the latter's 4 patients and observed that the deposit was not in the bursa but was located beneath the floor of the bursa. Codman reports Painter as agreeing with him that the deposits were beneath the bursal floor rather than in the bursa. Codman reported 1 case of his own in which the deposit was found at operation beneath the floor of the bursa. Codman was, therefore, the first to note the extrabursal position of these deposits. Many subsequent writers, in describing single operative cases, report the deposit as being in the bursa, but it seems highly probable that the great majority of them did not make exact observations as to the actual position of the deposit in relation to the bursa. Their writings contain many other fallacies which still permeate recent literature notwithstanding Brickner's forcible efforts to overcome them in his two excellent papers in which he reports 18 operative cases.

The literature is also confusing, because various writers use the terms "subdeltoid bursa" and "subacromial bursa" as though they were synonymous and interchangeable, whereas other writers believe these two terms represent two separate and distinct bursæ. The descriptions contained in different books on anatomy are likewise variable and confusing. My own experience indicates that Piersol's *Anatomy* and Codman's and Brickner's papers are

correct in describing only one bursa which lies in part beneath the acromion process and in part beneath the deltoid muscle.

Surgical literature contains detailed histories of numerous cases quite similar to those I have encountered and it seems needless to give the individual records in each of mine. Their clinical histories permit of dividing these patients into two main groups: (1) The acute and (2) the chronic.

The outstanding symptoms in the acute cases were pain and fixation of the shoulder-joint. The maximum pain was located commonly at the outer side of the arm over the lower half of the deltoid muscle, and only exceptionally at the site of the calcareous deposit just beneath the acromion process. In many of the cases, especially in those of longer duration the pain was referred from the neck all the way to the hand. Many of these cases had been undergoing treatment for brachial neuritis for many months. Several of them were tender along brachial nerve trunks, but none of them had reactions of nerve degeneration. In all of the acute cases pain was aggravated by active and passive motions of the shoulder, particularly in the direction of abduction and inward rotation. The pain was usually worse at night, apparently due to the backward drag of the elbow. The patients could not lie on the affected side because direct pressure aggravated their pains. Many patients had learned they could obtain some relief at night by placing the arm on a pillow in a position of slight abduction. The pain varied in intensity in different patients and in the same patient on different days. In some the pain was intolerable except when relieved by full doses of opiates. In the hyperacute cases the pain was as intense as that encountered in renal or biliary colic. In the non-operative cases there was a natural tendency for the hyperacute pain to ease up after a few days or within two weeks. On partial subsidence of the pain patients were prone to resume active use of the arm too early and pain recurred. Usually the pain became less severe and all the symptoms merged over into the chronic type of the disease.

In the acute cases the range of motion at the shoulder-joint was greatly restricted by muscle spasm and pain. There was never

complete fixation or ankylosis of the joint. The shoulder was least restricted in backward and forward swinging motions at the side of the body. Passive abduction of the arm, after gaining the patient's confidence, was usually free through an arc of about 10° directly outward from the side of the body. Further abduction, either actively or passively, was not possible in the shoulder-joint itself, but by rotating the scapula on the chest nearly all these patients were able to bring the arm outward to about a 40° angle from the lateral chest wall.

Inward rotation was restricted in all acute cases, as evidenced by an inability to place the hand behind the back. The patients were unable to comb the back hair and could not fasten rear suspender —or skirt-buttons. The men could not introduce the hand into the hip pocket. External rotation usually was fairly free, but was restricted and painful in several.

In a few of the acute cases, atrophy of the deltoid, supraspinatus and infraspinatus muscles was more marked than would be expected simply from non-use. In none of these patients was there a swelling or fluctuation indicative of fluid accumulation in the subacromial bursa; in six cases efforts to obtain fluid from the bursa by aspiration proved futile. One patient only had edema, which was moderate in amount and was located in the lower deltoid region. The same patient was the only one to exhibit any fever and her temperature barely crossed 100°. Skiagrams demonstrated the deposit of lime salts in every acute case.

The chronic type of cases either began as such or were originally of the acute type. Pain, both as to localization and radiation, was similar to the acute cases but varied greatly in intensity in the individual patients. In different patients the pain was constant, intermittent or remittent over a period of weeks, months or years. Mild exacerbations of pain, lasting from several days to a few weeks, were frequent, either as the result of exercise or without obvious cause. Several patients had very acute exacerbations in which the pain was as viciously severe as in the acute type of cases. In the milder cases and during remissions in the severer cases pain was felt only during extreme inward rotation or abduction to or above the shoulder level.

In elevating the arm from the side of the body to a perpendicular some of the patients would experience pain only when passing through that portion of the arc from 75° to 90°, and experience similar pain within the same arc on dropping the arm to the side. A few of these patients could go through the same motion painlessly by holding the humerus in a position of external rotation (palm up and elbow slightly flexed).

Limitation of motion varied greatly in the chronic cases. In some, motion was practically free except for causing bearable pain in abduction, in extreme inward rotation and in circumduction at the shoulder level. In the majority, however, there was more or less marked restriction in abduction and inward rotation either with or without restriction of external rotation. Limitations of motion were more marked during exacerbations of pain due to the pain and muscle spasm. Maintenance of the arm in its restricted position in long-standing cases led to contractures of the shoulder muscles and to atrophy, which was most evident in the deltoid, supraspinatus and infraspinatus muscles. In a few of these patients the chief complaint was disability rather than pain.

Many chronic cases apparently ran a self-limiting course and irrespective of treatment made a complete recovery at varying periods from a few months up to three years. A very small percentage of cases persisted over a longer period of years up to twenty years and they were prone to have months-long periods of intermission of symptoms. The calcareous deposit was demonstrated by a skiagraphic examination in every chronic case.

With but one exception, all the patients, both operative and non-operative, acute and chronic, who were suffering either from pain or limitation of shoulder motion had a characteristic area of localized tenderness just beneath the acromian process on the anterior or anterolateral aspect of the upper arm, usually over the site of the lesser tuberosity. One operative case of the chronic type did not exhibit any localized tenderness three weeks and two weeks respectively prior to his acute exacerbation, but was exquisitely tender the day of operation. The presence of a sharply localized finger-tip to quarter-dollar-sized area of tenderness was

found to be a valuable sign in making a differential diagnosis from a general arthritis of the shoulder-joint, as in the latter condition the head of the humerus is tender to finger pressure throughout its entire circumference. The majority of the patients, however, were not aware of having this area of tenderness until it was revealed to them by the surgeon's examination. Many patients were slightly tender over a corresponding area in the opposite and otherwise apparently normal shoulder. In several patients with unilateral symptoms, but with bilateral calcareous deposits, tenderness was absent in the shoulder that was free from pain and stiffness. The area of tenderness disappeared under the acromion in wide abduction (Dawbarn's sign) in all cases in which it was tested.

Nearly all of the 19 operative cases were either of the acute type or were in the acute exacerbation stage of the chronic type at the time they first came under observation, and almost all of them were operated upon within the first twenty-four hours thereafter. The first one of these cases, a physician, was operated upon in 1907 by Dr. Martin. In the first 8 of the 19 operative cases, the sole aim of the operator was to remove the calcareous deposit, and no effort was made to determine either the exact location of the deposit or the presence of possible pathology in the bursa itself. The deposit was removed in every instance and all but one untraced patient are known to have been cured. The conditions encountered in the operative field were studied very carefully in the subsequent cases.

At operation a sand-bag was placed under the scapula to tilt the patient away from the affected side, thereby rendering the field of operation more accessible. The arm, forearm and hand were swathed in a sterile sheet to permit of later independent manipulation. An incision was made, parallel to the fibers of the deltoid muscle, extending from the edge of the acromion process downward for 2 to 3 inches toward the insertion of the deltoid and crossing the greater tuberosity.

The deltoid muscle was split in the direction of its fibers by combined sharp and blunt dissection. The deeper muscle fibers were

carefully pushed aside to expose the roof of the subacromial bursa. The thin wall of this sac was then carefully incised for a distance of 1 inch or more. In only one instance was there any difficulty in entering the sac and that was because of extensive adhesions within the bursa. By retraction of the wound and manipulation, especially rotation, of the arm the bursal walls were separated to permit of an extensive survey of the interior of the subdeltoid portion of the sac. An attempt to illuminate the subacromial portion of the sac by introducing a small electric light in 1 case was unsuccessful. A curved hemostat or a finger, aided if necessary by manipulation of the arm, was then introduced to explore the interior of the sac. Eight of the earlier cases were not examined so thoroughly and it is possible some pathological changes may have escaped notice in them but on the whole the amount of pathology involving the bursa itself found in the eleven more recent operations was relatively insignificant.

In 1 case the bursal sac was completely obliterated by recent fibrinous adhesions which were readily broken up by the finger. In 3 cases there was some thickening and adhesions of the most dependent portion of the bursa. In 2 of them a small portion of the sac was excised, and in the third the adhesions were simply separated. In 1 of the above 3 cases and in only 2 others a trifling amount of serous fluid was found. In all but 2 of the cases the calcareous deposit could be seen as a gray patch and usually was palpable to a finger-tip as an area of altered resistance beneath the unopened floor of the bursa.

As the next step in the operation the floor of the bursa was incised over the calcareous deposit. In 4 cases this incision exposed the deposit. Usually, however, a deeper incision had to be made to expose the deposit which was found in the supraspinatus tendon. In 2 cases in which the deposits were situated on the deep aspect of the supraspinatus tendon there was no discoverable superficial index as to their location and they were sought by exploratory incision at the area indicated by the *x*-ray and by the localized tenderness. In 1 case the deposit was found at the first incision and in the other only after an extensive search.

These deposits varied greatly in consistency. One was not unlike the consistency and color of staphylococcic pus; usually the deposit closely resembled the appearance and consistency of the contents of a sebaceous cyst; in 2 the deposit was rather dry and chalklike, but not gritty; and in 2 it was granular and gritty.

The major portion of the deposit was lifted out with a blunt curette. Quite commonly the irregular walls of the cavity were smeared or infiltrated with the deposit and had to be trimmed away with knife or scissors. Multiple deposits in some cases called for secondary incisions into the tendon.

The subsequent steps of the operation were carried out in different ways. When there was a definite cavity in the tendon an attempt was made to obliterate it by fine chromic catgut sutures. In a few earlier operative cases the floor and the roof of the bursa were closed with catgut and drainage was not employed. More recently neither the floor nor the roof of the bursa was sutured and a small rubber drainage tube was inserted through the deltoid muscle for twenty-four hours to provide for oozing blood and serum which often were fairly copious. The deltoid fibers and fascia were united with three interrupted catgut sutures and the skin was closed by a continuous suture. The gauze dressing was held in place by adhesive plaster in preference to a bandage in order to favor early shoulder motion.

The postoperative position of wide abduction, so commonly recommended to prevent adhesions, was found so uncomfortable that it was early abandoned. Practically all these patients had only a bandage sling to the wrist and rested the arm in a position of moderate abduction on a fat, long pillow which rested partly on the mattress and partly across the lower chest and abdomen. They were not restricted to this position, but from the first day were encouraged, but not obliged, to remove the hand from the sling at intervals and extend the elbow; to shift the position of the arm on the pillow; to move the shoulder in any other direction they could and even to sit up in bed or in a chair. Beginning at the end of the second or third day they were obliged to begin passive motion in the direction of abduction by interlocking the

fingers of the two hands and using the well arm to elevate the bad arm. On the third or fourth day they were required to stand in a doorway or at some offset in the room and gradually "inch" their finger-tips up the wall. This exercise was repeated four or five times daily until they could reach the maximum height level established by the finger-tips of the sound side. During the early days of this exercise the upward climb of the fingers was assisted by using the sound hand to grasp and elevate the affected forearm or elbow and by having the patient step closer to the wall as the fingers ascended.

Beginning on the third day, or soon thereafter, the patient while sitting rested the arm on a table or on gradually increasing higher piles of books or pillows laid on the table and from time to time depressed the body to increase the range of abduction. Occasionally, within one week and frequently within ten or twelve days after operation, the full range of shoulder abduction was demonstrated by Codman's maneuver of having the patient stand with knees extended and touch the floor with his finger-tips.

About the fifth or sixth day efforts were begun to restore internal rotation by having the patient pass his sound hand across his back to grasp and make traction on the thumb or wrist of the affected side. It should be noted that, although all these exercises are carried out by the patient himself, they are largely of a passive character and do not call for much muscular effort on the part of the affected shoulder. Active exercises are encouraged from the first and insisted upon after the first few days. The exercises were started early to prevent adhesions and were preferably and usually carried out by the patients themselves. Because they could exercise their arms dozens of times daily and could keep their shoulder motions within the range of pain tolerance, they made more rapid and more comfortable progress than as though they had to depend upon a nurse or a physiotherapist. For the acute cases, in whom limitation of motion was due mainly to muscle spasm, the preceding exercises were adequate to restore full but somewhat labored motion within ten days' time.

In all the acute cases relief from the pain immediately followed

the operation. Frequently the patients, upon recovery from nitrous oxide-oxygen anesthesia, reported within one or two hours that the old pain was gone and they were usually more comfortable the first night after operation than they had been the few nights preceding it. The patients usually were able to leave the hospital within a week or ten days. Several physicians left the hospital on the first, second and third days after operation.

Cases of chronic type, with but two exceptions, were all operated upon during an acute exacerbation. Operation gave them relief from pain only to the extent to which the pain had been increased during the acute exacerbation. The pain they had before the acute exacerbation persisted after the operation and only disappeared after a few to several weeks.

At the time of operation on the chronic cases, in whom limitation of motion was at least in part due to contracted muscles, only moderate force was used in making shoulder manipulations to restore motion. Moderate force was frequently adequate to restore full motion, but sometimes only an incomplete range of motion was obtained. The chronic cases were instructed to carry out the same postoperative exercises as the acute cases. The chronic cases, however, made much less rapid progress, because of the persistence of their original subacute pain. Their own efforts at exercise very commonly had to be supplemented by surgeon, nurse and physiotherapist, both within the hospital (wherein their average stay was longer), and after going home. Baking, massage and vigorous passive motions had to be employed in many of these patients. A very good device for restoring motion in this and other types of shoulder fixed in adduction consisted of a clothesline rope and an overhead pulley, each of which was purchased at a ten-cent store, for the patient to use in his home. At the high points to which the patient could readily reach with his hands two loops were tied in the rope to serve as handgrips. The two ends of the rope were left long to facilitate the grasping of one loop in each hand. A downward pull on the rope by the upward extended sound hand elevated the affected hand and arm, and by seesaw movements of the rope the angle

of abduction was further increased. Again, this is a form of passive motion which was carried out by the patient himself.

Restriction of outward rotation disappeared spontaneously after operation in the acute cases but required corrective measures in a few chronic cases. I have gained the impression that the pain which persists after operation in the chronic cases clears up less rapidly under prolonged rest than under forced exercises, provided the latter are not overdone to the point of aggravating the pain. In several chronic and a few acute cases massage and special exercises, such as swinging Indian clubs and swimming, had to be employed to overcome atrophy of the shoulder muscles even after motion was fairly complete.

I have seen more than 25 shoulders in which calcareous deposits were definitely proven by *x*-ray examination but in which operation was not performed.

Four of these patients had bilateral deposits but had the deposit removed from one side only. One of these four was a physician who had angina pectoris of several months' duration, and recurring pain and stiffness of the left shoulder for over twenty years. He had never had any disability in his right shoulder. *X*-rays showed a definite deposit in each shoulder (Fig. 4). The left shoulder was tender and the right was not. It was difficult for him to differentiate between his angina pain and left shoulder deposit pain. He insisted on operation, which was performed on May 5, 1924, under local anesthesia. He left the hospital and went home at a distance of two hundred miles on the third day. Under date of September 25, 1924, he writes that after operation he "had some dull indefinite pain for some time, but at this time I am entirely free of any discomfort in that shoulder and have had no discomfort for some time." Concerning the unoperated right shoulder he reports: "I never had any discomfort in my right arm or shoulder until six weeks ago, when I was awakened by quite acute pain in the right shoulder which prevented my sleeping until after I had applied heat by means of an electric pad and then I slept through the night. On getting up I had a feeling of soreness and dull aching which persisted for several days, then disappeared, and

again made its appearance a week ago, was annoying for three days and at present seems to have gone. Unquestionably this pain is due to the calcareous deposit in my right shoulder and should it continue I will have deposit removed." An *x*-ray picture of his right shoulder taken on September 25, 1924, shows the same shadow as pictures taken on March 8, 1924 and on May 4, 1924.

A second patient with bilateral deposits, proven by *x*-ray, had had bilateral symptoms for many years. When she first came under observation she was having an acute exacerbation in one shoulder and the other shoulder was only slightly but rather continuously painful. Motion in both shoulders had been greatly restricted for years. I operated on the acute shoulder and removed the deposit. She was one of my early cases and I gave her an unduly favorable prognosis. With a personal experience based largely on acute cases, I was under the delusion at that time that excision of any deposit was almost synonymous with speedy cure of all symptoms and so advised her. Her acute pain was relieved by operation, but the chronic pain persisted and there was not much improvement in shoulder motion during the two weeks she was in the hospital. I have not been able to get any news of her condition since she went to her home in a distant town.

The third case of bilateral deposits was in a physician who had several weeks of mild symptoms during which two examinations failed to show any tenderness over his affected left shoulder. He then had a complete remission of symptoms, and after taking a bath one night at ten o'clock he was able to use a bath towel painlessly in the good old-fashioned seesaw way which required full range of shoulder motion in every direction. He then announced to his wife that he was completely free of his trouble. At three o'clock of the same night he was awakened by agonizing pain in the left shoulder. His shoulder exhibited the typical hyperacute tenderness and the typical limitations of motion of the acute type. An *x*-ray picture (Fig. 10*A* and *B*) taken the same day demonstrated a deposit in the left shoulder, but no picture of the right shoulder was taken. At operation the same

day, January 16, 1923, his bursa was found obliterated by fibrinous adhesions which were broken up with a finger and the deposit was excised. He left the hospital on the third day and resumed his work as a skiagrapher on the fifth day after operation. He has had no further trouble in his left shoulder. About one year later he began having mild symptoms in the right shoulder and an *x*-ray picture (Fig. 10*C*), January 19, 1924, revealed a definite deposit in the right shoulder. Several pictures taken since then show gradual absorption of the deposit. In the last picture, on September 11, 1924, it casts a barely perceptible shadow. He has had treatment by diathermia. The clinical symptoms have been of the milder remittent chronic type and were at about their worst when the last picture was taken.

The fourth bilateral case was a physician who had chronic, fairly constant pain for several months, with marked restriction of abduction of his left shoulder followed by an acute exacerbation and an operation on December 31, 1920. At operation his bursa was entirely free from any suspicion of disease and yet he was one of my worst cases of contractured muscles. By using a considerable amount of force and snapping "adhesions" during the operation, I was not able to bring his arm out to a full right angle. His deposit was removed. He left the hospital on the fifth day. The acute pain subsided, but the original chronic pain persisted for several months. He was an extremely busy out-of-town physician and could not be forced to carry out postoperative exercises, but eventually the pain left and the shoulder motion greatly improved. A skiagram was not taken of the opposite shoulder at the time of operation. Recently, I recalled that while he was in the hospital for his operation and subsequently he had complained of a painless stiff right shoulder and for that reason called him on the telephone to request him to have a skiagram taken of the right shoulder. He then stated that for the past few weeks he had been having periodic pains in the previously painless right shoulder, and a skiagram taken on September 27, 1924 shows a pinhead deposit in it.

A *B*

FIG. 1.—*A*. Internal rotation; large shadow twelve hours after onset of first symptom. *B*. External rotation; deposit concealed.

A *B*

FIG. 2.—*A*. Internal rotation; large shadow, shown free from bone. *B*. External rotation; deposit partly hidden, simulating an osteophyte.

A *B*

Fig. 3

A *B*

Fig. 4

C FIG. 4 *D*

FIG. 3.—*A*. Arm in adduction; large deposit. *B*. Arm in maximum possible abduction (about 85°); deposit apparently impinging on acromion.

FIG. 4.—Bilateral deposits. *A*. Left shoulder in external rotation, showing multiple deposits which (*B*) are concealed in internal rotation. *C*. Symptomless right arm in internal rotation. The deposit shadow overlaps the bone shadow and resembles a bony outgrowth, but stereoscopically the deposit shadow is free from the bone. *D*. Right arm in external rotation; humerus and deposit shadows superimposed. No change in right shoulder shadow for six months.

I have seen two non-operative cases of bilateral deposits with unilateral symptoms in the wives of physicians. One of these patients began nine years ago to have pain of a fairly constant character, and very commonly worse at night, in the left shoulder and radiating down the arm. She had marked atrophy of shoulder muscles. A skiagram from one angle only, taken in 1917, was negative. A bilateral skiagram (Fig. 11), taken on June 28, 1921, revealed deposits in both shoulders. After this picture was taken the symptoms in the left shoulder began to subside and she has

FIG. 5.—Huge deposit, on January 17, 1922; spontaneous absorption. Shadows entirely absent on April 13, 1922 and September 27, 1924.

not had any trouble in it for over two years. A skiagram taken September 29, 1924, shows disappearance of the large dense shadow in the left shoulder without much change in the tiny shadows in the right shoulder. She has never had any symptoms in the right shoulder.

The second patient slipped coming down stairs, grasped the banister and severely twisted her left arm in early January, 1924. The shoulder was uncomfortable for one week and then was free from symptoms for a month, when she rapidly developed severe,

constant pain causing her to walk the floor night after night. She took "gallons of medicine for neuritis." An *x*-ray picture of the shoulder taken July 4, 1924, disclosed a large deposit. Since then her pain has rapidly subsided and she now has only slight pain as the arm approaches the level of the shoulder in full abduction. Her right arm has always seemed perfectly normal, but a radiographic examination made on September 30, 1924, revealed a small and hazy but unmistakable deposit in the right shoulder and a complete disappearance of the large dense shadow formerly in her left shoulder.

In one instance I had the unusual experience of discovering accidentally bilateral deposits in a patient who had been skiagraphed for another lesion. Stereoscopic *x*-ray films were made of the chest of a patient who had metastasis to the lungs secondary to a cancer of the breast. The shadow of a calcareous deposit was shown in each shoulder, but both shoulders were free from symptoms.

Another instance of accidental discovery of deposits occurred in making a study of the supraspinatus tendon recently in six shoulders in the postmortem room. The fifth shoulder contained four small deposits, two being in the supraspinatus tendon and two in the subscapularis tendon. So far as could be learned the patient had never complained of any shoulder symptoms.

The majority of my patients did not have both shoulders *x*-rayed, hence other bilateral cases may have escaped detection.

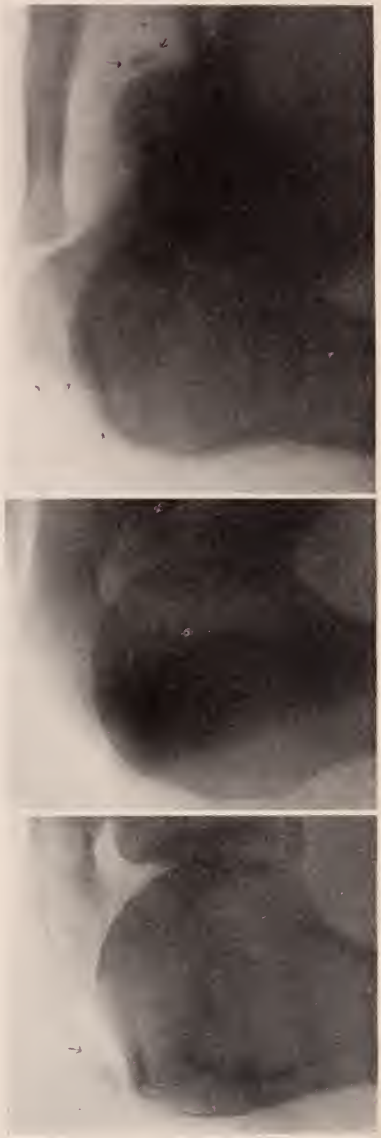
In addition to the preceding 3 cases of bilateral deposits in which there was spontaneous absorption of the deposit in the one shoulder of each case, I have seen 4 other unilateral non-operative cases in which there was a subsequent complete or almost complete disappearance of shadows in from four months to two years.

One patient with unilateral symptoms of hyperacute form in January, 1919, had a very large shadow (Fig. 5) which had almost competely disappeared in a picture taken three months later, but he still had painless marked limitation of abduction, which soon cleared up following the use of a rope and pulley. Pictures of both shoulders taken on September 28, 1924, were entirely negative.

A B

FIG. 6

FIG. 6.—Left shoulder. *A*. Internal rotation, large shadow. *B*. External rotation; deposit barely visible in area of acromion shadow.



A B C

FIG. 8

FIG. 8.—Right shoulder. *A*. July 15, 1922; external rotation; deposit visible. *B*. Internal rotation; deposit concealed. *C*. October 1, 1924. Almost complete spontaneous absorption. A new deposit has formed at the coracoid process.

A physician's wife had a moderately severe acute attack of pain and limitation of shoulder motion, with a characteristic point of tenderness. A skiagram (Fig. 7) taken on the third day showed

FIG. 7.—Right shoulder, May 31, 1920. Dense dumbbell shadow and a larger faint shadow. Skiagram on November 12, 1920 demonstrated complete spontaneous absorption.

A *B*

FIG. 9. *A*. Left shoulder. Large shadows found at operation to be composed of scores of pinhead-size deposits. Chronic intermittent symptoms for ten years. Acute exacerbation for three weeks. *B*. Symptomless right shoulder; small deposit.

a dense dumbbell-shaped shadow and a larger second definite but hazy shadow. She elected to try rest in bed with arm moderately abducted on a pillow until the acute symptoms subsided. Both shadows had disappeared in four months, but mild symptoms

recurred from time to time during the next two years whenever she attempted to play the piano for long periods, and playing golf was impossible. She has not had any symptoms for over a year. Her opposite shoulder was never skiagraphed.

Another patient with mild symptoms of chronic recurrent type had a small dense shadow which had nearly disappeared a year later, was entirely gone in eighteen months and he had not had any symptoms for the past nine months.

A physician had chronic symptoms with fairly acute exacerbations following an uncertain injury in an automobile accident. He was treated for brachial neuritis for four months, and then the first *x*-ray picture was taken and it revealed multiple deposits. Four months later the largest deposit had nearly disappeared, but the pinhead-sized ones were unchanged and there was no shadow in opposite shoulder. There was marked improvement in his symptoms, but movements such as the overhead swimming stroke cause pain.

Until more convincing evidence is forthcoming, I will continue to believe that the generally accepted view that these deposits can make a miraculous disappearance within a very few days is really due to an *x*-ray fallacy. I had two cases in which I formerly supposed deposits had disappeared spontaneously within five days as proven by *x*-ray evidence. Films at one angle only were taken in each case. I now suspect that in both instances the skiagram was taken at the favorable angle to show the deposit on the first day and at the opposite angle with the concealment of the deposit by the superimposed bone shadow on the fifth day. Unfortunately I have not been able to trace either the patients or their films in order to check up on this surmise.

One of these two patients was a rather curious case in a colored man. He had right shoulder subacute symptoms of sufficient severity to be anxious for operative relief. A single plate of each shoulder proved negative for the painful right shoulder and showed a dense typical deposit in the otherwise normal left shoulder. To eliminate possible error in the labeling of the plates, second pictures were made by another roentgenologist on the fifth day

A *B* *C*

FIG. 10.—*A*. Left shoulder. External rotation; deposit visible. *B*. Internal rotation; deposit concealed. *C*. Right shoulder. Small deposits which were partially absorbed in seven weeks and almost completely absorbed in eight months.

and no trace of the former shadow could be detected in either of the single plates taken of each shoulder. The patient was not operated upon and was not seen subsequently.

In several of my cases, and in many reported ones, the deposits have apparently made their appearance with amazing rapidity. Absolute proof as to the speed with which these deposits form has not been determined by a first skiagram which is negative and a second which shows a definite shadow. I have had several early cases of shoulder injuries *x*-rayed, hoping to clear up this point, but my efforts have been futile.

One of my cases was in a man who developed hyperacute unilateral shoulder pain after driving an automobile on a stormy night. A skiagram (Fig. 1) taken within twelve hours of the onset of symptoms showed a typical large, dense shadow and a corresponding deposit was found at operation three hours later.

It has been generally assumed that these deposits do not antedate the onset of symptoms, mainly for the reason that it is extremely rare to find them in routine *x*-ray examinations of shoulders except when the symptoms of the deposits are present. It has been argued that if these fairly common deposits could exist without symptoms they should be encountered frequently in skiagrams taken for other shoulder lesions. Elsewhere in this paper I have shown that (1) symptomless bilateral deposits in the shoulders have been found accidentally in stereoscopic films of pulmonary cancer; (2) a deposit has been present as long as three years without causing any symptoms; (3) a deposit had been present but quiescent for four months and then caused symptoms; (4) deposits have disappeared spontaneously, and (5) a large dense deposit has been present and has not been demonstrable in an *x*-ray picture of the shoulder taken from only one angle, especially if it was the common position of having the patient's hand resting on the chest or abdomen. In view of all these facts, I believe that the large dense deposits which are found within the first day or a few days after the onset of symptoms must be instances of preëxisting latent deposits.

The remainder of the non-operative cases were all of the milder

subacute type and have drifted out of touch. The nature of their affection was explained to them with suggestions as to treatment and they were advised to return for operation in the event of an

A

B

FIG. 11.—*A*. Bilateral deposits. *B*. Left shoulder in 100° abduction on June 28, 1921. Deposit far under acromion. On July 29, 1924 large left deposit absorbed. Small right and left deposits unchanged.

acute exacerbation. That so many of them have not returned would seem to imply that many of them experienced the frequent betterment that occurs with the lapse of time.

All recent writers agree that injury to the tendon of the supraspinatus muscle is a definite etiological factor in the production of calcareous deposits, yet they all agree that a history of a definite single trauma is unobtainable in a considerable percentage of cases. According to the commonly accepted theory, a partial rupture of the supraspinatus tendon is the injury which is usually responsible for the deposition of the lime salts. Localized tears in this tendon have been observed at operation and postmortem in the absence of deposits, and they have also been found at operation at the site of the deposit. In none of my cases was I able to determine that the cavity containing the deposit was due to rupture of tendon fibers. If partial tendon rupture had caused the cavity in any of them, all evidence of rupture had been masked by inflammatory changes before operation was performed.

An unusually high percentage of my cases occurred in physicians and physicians' wives. Only a few of this intelligent group were able to assign an adequate trauma as a cause for their symptoms. I believe that in a fairly high percentage of cases the deposition of the lime salts occurs quietly as the result of mild repeated traumata, and precedes, by days, weeks or months, the onset of the clinical symptoms. After the deposit has formed a very mild trauma may then incite an acute inflammation with a rapid development of the classical clinical symptoms. It also seems probable that some of the supposed partial tendon ruptures found at operation or autopsy may in reality have been tendon defects (cavities) caused by a deposit which may still exist or may have been absorbed. Or a tendon weakened by a deposit may rupture from slight violence in which event the partial rupture is the result and not the cause of the deposit.

As in several of my patients, Moschcowitz and others have found microscopically that necrosis of tendon tissue is present in these cases. Moschcowitz has made a careful pathological study of the tissues from Brickner's operative cases and he has found that the lesion is one of "tendonitis," necrosis and calcification. These findings are borne out by pathological reports in my cases.

The blood supply of tendons is notoriously poor. The tendon

of the supraspinatus is so situated that it is frequently subjected to single accidental violent trauma and to milder, many times repeated occupational pinches between the acromion and the head of the humerus in abduction. A partial rupture or a violent contusion either from pinching or from an external blow might directly destroy the scanty blood supply. Milder frequently repeated traumata of the occupational variety might readily produce the same result indirectly by chronic inflammation. The localized exemia would then result in localized necrosis and deposition of lime salts.

The tendon of the supraspinatus is subjected to frequent and repeated traumatism both by muscular action and by direct and indirect violence. The supraspinatous is relatively a very small muscle to be a principal abductor of the shoulder, and, being attached to the short end of the long widely-moving lever represented by the arm, is particularly susceptible to lesions resulting from muscular strain. It is therefore not surprising that partial rupture of the tendon may result from sudden unexpected muscular strains such as occur when the patient suddenly abducts the arm to prevent falling. In many of the reported accidents it is impossible to determine whether the main factor in the injury is the muscular strain or the internal violence due to pinching of the tendon between the humeral tuberosity and the acromion process in the position of abduction. Both forms of violence probably act together in many of these cases, and it is possible that the point of partial rupture of the tendon may be determined by the site at which it is compressed between the humerus and acromion. This mechanism would serve to explain why rupture and contusions are so common in the distal end of the tendon and are apparently so rare in the muscle fibers and in the proximal end of the tendon.

Other forms of muscular violence which seem to have played a part in these cases are: (1) Overuse, as in a baseball pitcher; (2) unaccustomed use, as in playing baseball without proper training or in throwing a heavy club into a high fruit tree; and (3) occupational stress with the arms held in slight abduction, as in piano-players, typists and machine operators. In all three of

these groups the element of pinching of the tendon cannot be eliminated and it may indeed be the prime factor.

The acromion process might very reasonably be regarded as an essential, although an extracapsular, part of the shoulder-joint. Stevens has shown how the short rotators of the arm tend to prevent the upward thrust of the humerus caused by the contraction of the abductor muscles. The normal clearance space between the acromion and the humeral head is very slight, and there must be many occasions when the short rotators fail to act perfectly and then the upward thrust of the abducting humerus is arrested by impact against the acromion. Particularly is this impact prone to occur in the arc of abduction between 75° and 85° as the projecting tuberosity passes under the acromion process or coraco-acromial ligament. The acromion process may very reasonably be regarded as an essential part of the shoulder-joint itself, as it resists the tendency to upward dislocation of the humerus and affords a gliding support to the humeral head during abduction and rotation. In other joints intracapsular articular cartilages cover the bone surfaces which engage in a similar gliding function. The extracapsular subacromial bursa is a poor antifriction substitute for the articular cartilages and undue friction results between the acromion and the tendon covered head of the humerus. The supraspinatus tendon, as it winds over the head of the humerus, is thus exposed to repeated contusion and friction in a way not encountered with any other muscle or tendon.

Several writers, including Codman, make only passing mention of contusion as the cause of the tendon injury, but I believe contusion is a very important factor. Many patients with shoulders otherwise normal, both clinically and roentgenographically, exhibit marked tenderness over the tuberosities due almost certainly to mild occupational traumata.

Falls on the outstretched hand or on the elbow constitute a form of indirect violence in which the tendon is forcibly compressed between the humerus and the acromion. In these accidents the element of muscular action frequently cannot be eliminated and possibly it may be a contributing or even the main factor in many of them.

The supraspinatus tendon is exposed to direct violence by falls or blows on the point of the shoulder. I think the importance of this mechanism has been overemphasized. Frequently patients get hurt in somewhat complicated accidents and because of the shoulder pain assume they must have been struck in that region. On cross-examination they cannot recall having sustained a blow on the shoulder and the nature of the accidents were such that muscular violence or abduction compression of the tendon or both could have happened. A perusal of case histories does not indicate this form of direct trauma is at all frequent.

The reported cases of calcareous deposits have not followed severe shoulder injuries. It seems probable that these deposits do occur after severe injuries and are then erroneously regarded as fractures of a tuberosity. I have recently had a dislocation of the shoulder which exhibited an *x*-ray shadow which did not permit of differentiation between shell fracture and calcareous deposit. An *x*-ray picture, four months later, demonstrated complete disappearance of the shadow. A fracture fragment may have been absorbed, but I am inclined to believe that the original shadow was caused by a deposit. If the possibility of a deposit is kept in mind in all shoulder injuries and a careful comparison is made of the tuberosities in stereoscopic pictures of both shoulders, I anticipate that many of the suspected fractures of a tuberosity will turn out to be calcareous deposits. On the other hand, I suspect that many of the cases which have been reported in the past as fractures of the greater tuberosity from muscular violence, often mild in character, were in reality cases of calcareous deposits.

My findings agree with Brickner's views, that some factor other than trauma, probably a disturbed metabolism, plays a part in these cases. Brickner points out that "the deposit occurs only in adults; it occasionally is encountered first in one shoulder, then in the other; in some persons the deposit undergoes absorption, in others it persists; although a common affection, many persons using their arm in the same way and subjected to the same influences never develop it; it occurs among the muscular and athletic as well as the sedentary and asthenic, in females as well as in

males; no other hypothesis can explain why in some persons, within a day or two after some mild internal violence or an external injury, the roentgenogram will reveal this characteristic deposition of lime salts above the greater tuberosity of the humerus." I might add that the symptomless development of deposits in the absence of acute trauma is further evidence in favor of metabolic disturbances.

The patients in whom these deposits occur are not of a gouty type. Infection and toxemia are not factors. Only 1 of my patients had fever and her temperature rose barely over 100° F. She had an associated edema of the lower deltoid region and was the only 1 of my patients that had edema. She was an early acute case, was 1 of the only 3 of my patients who had an effusion within the subacromial bursa and was 1 of a different group of 3 in which I found some localized thickening and adhesions of the bursal walls. Cultures from the bursa and from the deposit were negative, as were all the cultures taken on several other patients. Many of my cases, before the diagnosis had been made, were treated for various forms of toxemia without benefit to the shoulder.

On skiagraphic examination the calcareous deposits cast a shadow of varying density. The shadow may be thin and hazy or quite as dense as bone. Shadows of both extremes may exist in the same patient. The deposits may be single or multiple, and may be unilateral or bilateral. They vary in size from pinhead to a silver quarter-dollar. They occupy different positions in relation to the head of the humerus in different patients. They often escape detection when a skiagram is made from only one angle, because the deposit shadow is superimposed on the bone shadow of the humerus or the acromion.

I feel greatly indebted to Dr. Henry K. Pancoast, Dr. Donald J. Zulick and Dr. B. P. Widmann for their kindness and courtesy in making the majority of the skiagraphic examinations in my patients and for testing out various methods of demonstrating the presence of these deposits. Their painstaking examinations often revealed the presence of deposits in patients who had had negative

x-ray pictures taken elsewhere within a previous few days. I am convinced that many of these deposits are not shown by the ordinary *x*-ray examination of shoulders.

In making a skiagraphic examination of the shoulder for calcareous deposits, Dr. Pancoast advises that "the rays should be directed from above downward, and from within outward, in order to show a space between the shadows of the acromion process and the head of the humerus. The calcareous deposit is usually brought still more into prominence by external rotation of the upper arm. From the diagnostic standpoint more information can be gained as to the exact location by stereoscopic plates made on the Bucky table. This procedure is also more likely to show deposits hidden by the head of the humerus, for the reason that there is more penetration of the bone."

If stereoscopic pictures are not taken, at least two skiagrams should be made in every case. In one the arm should be held in inward rotation to the extent that the hand of the flexed elbow rests on the patient's chest. In the other the arm is rotated externally by flexing the elbow to a right angle and turning the hand as far away from the body as possible which usually means the back of the hand rests on the table on which the patient is lying. In one position or the other the deposit shadow will usually be shown clear of the bone while in the opposite position even dense deposits are frequently obscured or totally hidden by the superimposed bone shadow. Very exceptionally the two shadows may be superimposed in both positions, hence the desirability of stereoscopic plates before making a negative *x*-ray diagnosis. In an unusual case now under observation, *x*-ray films in both positions of rotation show two small shadows which simulate deposit shadows overlaid by bone shadow. Stereoscopic examination shows these shadows lying within the humeral head and they are probably due to localized areas of bone condensation. The patient is a physician's wife and has the characteristic Codman symptom-complex.

Recently, in a few cases, I have been able to predict which position of rotation will disclose the deposit, if one be present, by studying the position of the tender area in relation to the humerus

and the direction which the *x*-rays will travel to strike the film. Whether this observation will hold good even in the majority of cases remains to be seen. I believe the tender area below the acromion coincides with the site of the deposit.

The symptom-complex in these operative and non-operative cases of calcareous deposits is exactly the same as occurs in other patients in whom the most careful *x*-ray examinations fail to reveal any evidence of a deposit.

Prior to the appearance of Codman's classical paper on "Stiff and Painful Shoulders," in 1906, patients with these symptoms were erroneously labeled as brachial neuritis, periarthritis, circumflex nerve paralysis, rheumatism, contusion of shoulder and so on. Similar erroneous diagnoses are very prevalent at the present time. Codman explains these symptoms as being due mainly to an inflammation of the subacromial bursa. In his original paper Codman mentions injuries to the supraspinatus tendon as incidental to injury of the bursa; but in his later papers, while still regarding the major lesion as being one of bursitis, he emphasizes the importance of the supraspinatus injury as part of the picture. Subsequent writers have followed Codman in ascribing the major lesion to the bursa and the minor lesion to injuries of the spinatus tendon. My own limited experience would indicate that the bursal lesion forms the minor feature in these cases, and that the injury to the supraspinatus (or much more rarely the infraspinatus) tendon constitutes the dominant lesion. The supraspinatus tendon is subjected to practically the same pressure as the bursa between the acromion and the humeral head when the arm passes through the arc of abduction. The tendon is subjected to the same violence as the bursa from direct trauma as from a blow or fall on the shoulder. Indeed by the substitution of the word "tendon" for "bursa," or for "bursa and tendon," one can adopt Codman's own description of etiology, causation of symptoms and treatment, and apply it with about equal force to the tendon as being the primary and essential lesion in all the acute and chronic cases irrespective of whether a deposit is present or not. A sore tendon presumably resents being pinched just as

vigorously as does a sore bursa. Partial rupture of the tendon is a necessary prelude to a tear in the bursa when the two coëxist from muscular violence. As between these two injuries the tendon rupture would seem to be the more serious. Although the bursa is fairly adherent to the tendon, yet it seems in some cases that partial tendon rupture might occur without tear of the bursa; particularly is this true in the cases in which a deposit (which presumably occupies the cavity caused by the rupture) is situated on the deep aspect of the tendon and incisions have to be made through intact tendon fibers before the deposit can be exposed. That was the location of the deposit in 2 of my cases. In nearly all carefully observed cases the calcareous deposit has been found both by others and myself beneath the bursa, often imbedded within the tendon, where it is not in direct contact with the bursa at any point. If these deposits were due primarily to lesions of the bursa, it is difficult to understand why many of them are not found in the roof of the bursa. In all of my acute cases removal of the deposit only caused immediate cessation of the original pain, notwithstanding separate incisions having been made through the roof and the floor of the bursa. If simple tears or contusions of the bursal walls can result in such severe symptoms as these patients suffer, then it would seem logical that the immediate effect of the operation should be an aggravation rather than a cessation of symptoms. Nowithstanding the incisions in the bursal walls not having been sutured, these patients soon regained their full range of motion. It therefore seems illogical to assume that either bursal contusion or tear is the likely cause for the months- or years-long duration of symptoms in these patients. The paucity of lesions found in the bursa in my operative cases indicates that bursitis is an infrequent complication rather than a constant coëxistant lesion. I think the evidence at the present time is conclusive that calcareous deposits do not originate either in the bursa or in its walls and that the term calcifying subacromial bursitis is a misnomer.

It is very important for surgeons to realize that these deposits are not in the bursa, but beneath it. One of my surgical acquaint-

ances was unable to find the deposit in three of a dozen cases shown by the x-ray because he limited his search to the bursa and did not explore beneath the bursal floor.

The treatment of cases of calcareous deposit will depend upon the stage at which patients apply for treatment. I no longer hold my former radical view that all cases of deposit should be operated upon. Accidentally discovered quiescent deposits do not require operation. If a deposit is causing acute agonizing pain, its removal affords the promptest and most certain method of relief and cure. In between these two extremes are individual cases of all degrees of severity of pain and disfunction of the shoulder, and the decision as to operation is left largely to the patient. The more prolonged or more severe the pain, or the more serious the shoulder crippling, the greater is the need for operation. Awaiting the spontaneous absorption of any given deposit is a very uncertain proposition. Even if it does disappear, the symptoms may, but not necessarily will, persist or recur for some months in lessening severity after the deposit has been completely absorbed. The removal of the deposit, in chronic cases at least, can be accomplished very comfortably to the patient under local infiltration anesthesia. Gas-oxygen anesthesia should be employed for the hyperacute cases in which the slightest touch or movement causes severe distress, and for the chronic cases in which it is necessary to manipulate the shoulder to overcome muscular contractures or to break up adhesions. The chronic cases with contractured muscles that I have operated on usually came during an acute exacerbation brought on by vigorous efforts at passive motion. In the past I have been unduly influenced by the evil effect of passive motion in causing the acute distress before operation, and, fearing to add to that distress, have refrained from making any very forcible manipulations at operation to overcome the restricted shoulder motion. I think this policy has been a mistake, as removal of the deposit invariably has relieved the pain of the exacerbation and forcible manipulations after removal of the deposits are not apt to result in any more pain than they would in any other contractured shoulder free from deposit. It therefore seems advisable to

use a fair degree of force to loosen up the contractured shoulders at the time of operation.

The use of excessive force in making manipulations of the shoulder or of any other joint is not justifiable. Excessive force means excessive inflammatory reaction and pain, and inability to carry out passive motion over such a long period that the contractures recur. The employment of excessive force in the shoulder may mean fracture of the humerus, dislocation of the shoulder or rupture of the axillary vein. Moderate force, by the Sir Robert Jones method of manipulation, is frequently sufficient to restore complete range of shoulder motion; but, if not, the surgeon should be satisfied with partial restoration of motion at the time of operation and later secure full range by having the patient use the overhead pulley and rope. Rarely the patient's efforts will not suffice, in which event it is better to resort to a second and third manipulation, under gas anesthesia, with moderate force, rather than to have used excessive force at the original operation.

Both acute and chronic cases should receive postoperative treatment, along the lines previously indicated, until there is complete relief from pain, from stiffness of the shoulder and from muscular atrophy.

I have gained the impression, in my non-operative cases, that the distress in acute cases and the acute exacerbation of symptoms in chronic cases are due to an acute inflammation superadded to the chronic inflammation which originally caused the deposit. This acute inflammation with its increased blood supply results in absorption of the deposit irrespective of treatment or lack of treatment. Thus far I have observed absorption of a deposit only after moderately or viciously acute symptoms. Quiescent deposits have neither diminished nor enlarged while under observation. In the cases of calcareous deposits not operated upon, treatment should be directed toward safeguarding the patients from further trauma and keeping them comfortable pending spontaneous absorption. The patients should be instructed to refrain in so far as possible from performing those shoulder motions which their own personal experiences have shown to cause pain. Each time

pain is inflicted the underlying lesion is subjected to further trauma with consequent aggravation or prolongation of clinical symptoms.

Intelligent patients soon learn various methods of avoiding pain. For instance, an individual with a deposit in the right shoulder will transfer many of his activities to his left hand. The pain caused by putting on a coat or overcoat in the usual way can be avoided by complete insertion of the affected arm into the sleeve first. A woman will place her skirt on hindside foremost so as to fasten its button in front and then rotate the skirt into position.

In those cases in which occupational traumata aggravate symptoms, it is desirable, but seldom possible, to have the patients make a temporary change in occupation. The inability of a skilled workman to change his occupation may be a determining factor in favor of operation.

In those patients in whom occupational traumata are due to holding the arms in the abducted position (as in typists, piano-players and machine operators) it will frequently be found that the abduction and traumata can be overcome directly by lowering the level of the machine or by raising the seat, or if the patient stands at work by placing a small platform at the base of the machine. This absolute or relative lowering of the machine level automatically brings the elbows closer to the sides of the chest and thereby removes the abduction element as a cause of the traumata.

Active abduction by increasing the strain on the inflamed supraspinatus tendon increases pain. Passive abduction to an angle of about either 60° or 120°, or rest in abduction at either of the same angles, relieves the pain by relieving the strain on the supraspinatus. Abduction, whether active, passive or at rest between 70° and 95° of angulation increases pain by compressing the tendon between the acromion and the tuberosity of the humerus. Rarely a patient learns by his own experience that wide abduction, as obtained by tying his wrist to the bedhead or resting his hand under his head, gives relief at night. Many surgeons endeavor to treat their patients by holding the arm at the 120° angle on various forms of splints or plaster casts, or by tying the forearm

or wrist to the head of the bed. This position shortens the duration of acute symptoms, but it is so uncomfortable that I have abandoned it, as the patients were prone to consider the treatment worse than the disease. A 40° to 60° angle of abduction can be obtained at night by resting the arm and forearm on a pillow which is placed with one end on the mattress and the other end over the patient's chest and abdomen. The same position is obtained by day, while sitting, by resting the arm on a pillow which is placed on the arm of a chair and across the lap or on the top of a table. Sedatives may be required to procure sleep at night. If pain is so great as to require morphine, operation should be urged instead.

Physiotherapy in its various forms may be helpful, but if used injudiciously may cause marked aggravation of symptoms. Several of my chronic operative cases first came under observation during an acute exacerbation immediately following vigorous massage and passive motion by physiotherapists. Gentle massage combats the tendency to atrophy and may relieve pain, but it should not be employed directly over the tender area. Heat in its various forms commonly ameliorates the pain. Many patients find that an electric pad applied to the shoulder at night is a sleep producer. Harris claims to have cured cases of calcareous deposit by diathermia. He apparently refers to symptomatic cures only, as he did not follow up his cases by *x*-ray examinations to determine whether the deposits had been absorbed. I have tried diathermia, but am not convinced that it or any form of treatment has any specific effect in causing absorption of deposits.

The tendency toward the formation of adhesions and the contracture of muscles must be overcome by early and daily resort to full abduction of the shoulder. This can be accomplished painlessly by having the patient stand with knees extended and touch the floor with his finger-tips.

Recurrence of a deposit is a reasonable possibility, but thus far I know of no instance in which one has recurred after having been either absorbed or removed by operation.

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DISCUSSION

Dr. Joseph Sailer: Let me first make a statement as to diagnosis by mail. I advised the patient to consult a physician and suggested that an x-ray of the shoulder be taken. To make diagnosis of bursitis on symptoms alone is not justifiable. I do not think the question of the rate of the calcareous deposit is of much interest to the internist. The important thing is we have in these cases a collection of calcareous material, whether it collects rapidly or slowly we do not know. There is evidence in both directions. Whether the calcareous material causes pain at one time and then becomes totally quiescent at another is not entirely settled. Whether that calcareous material may be absorbed is also undetermined at the present time. The degree of pain is sometimes extreme. There are different ways of estimating pain—the least valuable being the statement of the patient; but when the patient night after night is prevented from sleeping; when small doses of morphine give no relief and when even large doses of morphine do not give any permanent or complete relief; if the patient develops various vasomotor symptoms associated with severe pain such as sweating, pallor, weakness of pulse during excess of pain and particularly when this patient, offered the opportunity of operation, grasps that offer eagerly and is anxious, as at least was one of Dr. Carnett's patients, to have that operation performed with the least possible delay, it is reasonable to assume that a very extreme degree of pain may be associated with this condition. There is one thing that interested me in one of the cases Dr. Carnett threw on the screen, this patient had very severe pain in the shoulder, a very large amount of calcareous material poured out when the operation was performed, the largest I have seen, and Dr. Carnett said it was the largest he had seen in his cases. It was

thought that the pain would be immediately relieved; but the patient suffered for months as much after the operation as she had done before. Finally, Dr. Fielding Lewis examined her, found she had a pair of badly infected lingual tonsils which he removed, and immediately after removal of these tonsils, with the pus pockets they contained, the pain disappeared. This paper offers much material for speculation. It is easy to say that traumatism of the shoulder localized a focus of infection causing pain in that shoulder; but there is no definite evidence that this is actually the case. One thing that impresses me is the frequent absence of any definite traumatism. I had a bursitis, I think I was one of the first cases Dr. Carnett saw. I can recall to this day the extreme severity of the pain, and in going back over the history of my past life, thinking of the physical sins I had committed that might produce traumatism of the shoulder I could not recall any one thing even the most trivial injury to that shoulder that had ever occurred.

Dr. David Riesman: Pain in the shoulder, which Dr. Carnett and Dr. Sailer have so well depicted, may be due to a variety of causes; usually perhaps it is due to brachial neuritis. However, in cases with identical symptoms we may find in some the presence of a calcareous bursa, in others nothing whatever on *x*-ray examination. In the cases due to brachial neuritis it is always possible to discover a point of exaggerated tenderness upon pressure above the clavicle.

It is, of course, possible that a long persisting bursitis may gradually involve the nerves of the brachial plexus and lead to exquisite tenderness.

Another cause of shoulder pain is ordinary arthritis; another is cervical rib, but the most important and curious is tumor of the lung. Dr. Pancoast and I have had two cases which in the beginning presented perfectly typical symptoms of bursitis or neuritis. In the early stages the *x*-ray revealed nothing, perhaps because it was limited to the shoulder. Later an examination was made of the shoulder and lung, and the tumor found. This is perhaps the most important point to which I want to call attention.

Dr. Nassau: I congratulate Dr. Carnett upon the thoroughness with which he has studied this condition. Many patients suffer with indefinite pains which are the result of subacromial bursitis, together with calcareous deposits in the tendon of the supraspinatus muscle, and the condition goes unrecognized. We must not forget that sometimes simple bursitis without calcareous deposit will get well in course of time, but it takes a long time and the permanency of the cure is by no means certain. I remember one patient who had been treated for a long time for so-called

rheumatism of the shoulder. She had had three teeth removed for supposed focal infection and the bursal condition was so painful that she was absolutely disabled. Removal of the bursa effected a complete cure. Upon one point only do I disagree with Dr. Carnett: I have never seen any of these wounds in which it was necessary to insert a drain.

Dr. Carnett (closing): The patient to whom Dr. Sailer referred was the only one of my patients in whom a complete recovery was unduly delayed. Her affection (Fig. 3) was of the chronic type, from which prompt complete relief is not to be expected. She did improve immediately following operation to such a degree that she was able to drive an automobile. Atypical shoulder pains then recurred and were associated with even more severe pain and tenderness of intercostal nerves. The possibility of recurrence of the deposit was excluded by skiagrams. The patient's general condition was far below par. She became exhausted after walking only three or four squares. Her prompt recovery after the removal of infected tonsils is of special interest because she is the only patient of my entire group in whom toxemia seemed to play any part. Many of the other patients had had teeth and tonsils removed and other foci of infection treated without benefit before a correct diagnosis of deposit was finally made.

Dr. Riesman's case of lung cancer is a very interesting example of an unusual cause for obscure shoulder pains. There are many more common causes for shoulder pain such as true brachial neuritis, arthritis, bone lesions, cervical rib, "rheumatism," angina pectoris, and numerous other affections. The most common cause of all, however, for stiff and painful shoulders is so-called subacromial bursitis although the most careful skiagraphic examinations will reveal a calcareous deposit in only the minor percentage of them.

I agree with Dr. Nassau to the extent that I do not regard drainage as essential but I am convinced that drainage for twenty-four hours lessens postoperative discomfort and does not delay healing of the wound.

DYSTROPHIA ADIPOSOGENITALIS, WITH ATYPICAL RETINITIS PIGMENTOSA AND MENTAL DEFICIENCY—THE LAURENCE-BIEDL SYNDROME[1]

A Report of Four Cases in One Family

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The purpose of this report is: (1) To place on record the histories of four members of one family who present overgrowth of fatty tissue and undergrowth of the genitalia—the so-called Froelich syndrome—associated with other abnormalities of development, including retinal atrophy with pigmentary filtration; (2) to call attention to previous reports of cases so closely parallel to ours, that we may, with Biedl and Raab, look upon the condition as a definite syndrome.

Catherine L., a girl of Italian parentage, aged seventeen years, was admitted to the medical ward of the Jefferson Hospital, October 22, 1923. She was delirious and had a high fever. The cause of this was determined to be acute pyelitis. Her temperature soon became normal, but after a few days rose again, and again subsided; and thus during November and December she continued to have flights of fever lasting for several days. Finally, shortly after the New Year, her temperature remained constantly normal, all evidences of pyelitis having disappeared. During the

[1] Read November 5, 1924.

period of this illness we had noted with interest the girl's strange appearance, odd behavior and remarkably poor vision; and during an afebrile interval had had her eye-ground examined by one of our colleagues (Dr. Heed), who recognized the condition present; but not until the acute infection had entirely subsided, did we deem it opportune to make a thorough study. In this we had the collaboration of our colleagues Dr. H. F. Hansell and Dr. F. X. Dercum.

Questioned concerning her family, Catherine informed us that there were 8 children; 3 others, like herself, fat and with poor vision; 4 thin, and with good vision. The 7 were brought to the dispensary and studied; the father and mother were seen at their home. The photographs of the affected children are reproduced in Figs. 1, 2, 3, and 4.

The father, a day laborer, aged sixty years, was born in Italy, about 100 miles north of Rome, in a healthy district where no endemic disease prevails. He was the first born of a family of 6, 4 boys and 2 girls, all of whom are living and well. Neither he nor his brothers, sisters, or parents, suffered from known visual defect. None has exhibited marked adiposity, polydactylism deafness or idiocy; nor, in so far as he could inform us, were these phenomena present in other relatives. This, however, may indicate merely ignorance of family ramifications, or the peasant's failure to take notice, and does not necessarily imply absence of such dystrophies in previous generations, or in collateral lines.

The same holds true as to the mother, who is fifty-two years of age, and has no known kinship with her husband. She was born in the same district in Italy (the Abruzzi); was fifth in a family of 6, 1 boy and 5 girls. She married when twenty-one years of age, and in addition to her 8 living children had 1 miscarriage. This occurred without known provocation, in the second or third month of her second pregnancy. Both father and mother have always been healthy, and in both the blood Wassermann reaction is negative. Of their 8 children 4 are abnormal, as indicated in the following list:

Male, aged twenty-five years, normal.
Male, aged twenty-one years, *abnormal.*
Female, aged nineteen years, normal.
Female, aged seventeen years, *abnormal.*
Female, aged fifteen years, *abnormal.*
Female, aged thirteen years, normal.
Male, aged eleven years, *abnormal.*
Female, aged nine years, normal.

We might add, as to the last named, that, both physically and mentally, she is uncommonly alert, acting as shepherdess to the abnormal flock on their visits to the hospital.

Detailed description of the affected members of the family follows:

Case I.—Catherine (Fig. 1), the child who first engaged our attention, had a normal birth and seemed a fat, normal infant, except for six toes on the right foot, one of which was later amputated. Dentition began at the fifth or sixth month; she began to walk at one year and to talk at two years. She had measles and whooping-cough, from which she made good recovery. Diminution of vision became noticeable at about the age of fifteen years, and has been progressive since. She did not menstruate until she was about seventeen years of age (May, 1923), and then not again for nine months. One month prior to her admission to the medical service she had been brought to the hospital with a diagnosis of acute appendicits, but at operation an ovarian cyst, with twisted pedicle, was discovered.

Physical examination in the medical ward, after she had recovered from the attack of pyelitis (January, 1924), showed a very stout, short girl, with high color and an ordinary amount of coarse black hair. She weighed 152 pounds. Her height was 144 cm.; her span, 142 cm.; from symphysis to sole she measured 71 cm., and from symphysis to vertex, 74 cm. Her expression was staring, but not vacant. She found her way with difficulty, bumping into objects as she moved about.

The face is round, the nose small, the teeth normal, the palate

high arched, the tonsils large and cryptic; the neck is short and chunky and the occiput is sheer. There is no adenopathy. The *thyroid gland* is palpable, but not enlarged. The breasts are large and pendulous. *Adiposity* is marked and generalized, but is especially of the mammary, mons and girdle type. The hair growth in the axilla and pelvic regions is scanty. It has the usual feminine distribution over the mons pubis. The heart and lungs

Fig. 1

seem normal. Abdominal examination is negative, except for two scars, one in the appendiceal region and one in the midline. The arms and legs are fat and shapeless, the thighs being especially thick. There is a slight degree of genuvalgum. The hands and feet are short, thick and broad. The fingers, although short, are tapering, while the toes are chunky. The nails present nothing of special interest, but are on the whole, poorly developed. Re-

flexes are normal. *Mentality* is markedly deficient, although she answers questions with short, snappy replies, and has a sort of infantile wit. Her vocabulary is limited, but there is no difficulty in speech. She is happy, is easily amused and laughs a great deal.

Eye examination (H. F. Hansell) shows "partial night blindness; fields limited concentrically to a small area around the fixation point; pupils dilated, left a trifle larger; no reaction to light or convergence; convergence almost in abeyance; no muscular paralysis; a few small vitreous opacities, one adherent to the posterior lens surface on right; optic nerve and retina partially atrophied; retinal vessels diminished in caliber and length; pigment spots scattered throughout each fundus. Diagnosis, 'atypical retinitis pigmentosa.'"*

Ear examination shows a bilateral chronic catarrhal otitis media.

Laboratory examination: The urine output was about 1 liter in twenty-four hours; examination negative. Blood count shows: Hemoglobin, 57 per cent; red blood cells, 3,690,000; white blood: cells, 10,000; differential count normal. Blood-pressure averaged 110/70. Blood Wassermann was negative. Basal metabolism was − 19. Sugar-tolerance tests showed a deficient response to the ingestion of 1.75 gm. of glucose per 1 kg. of body weight.

Gynecological examination shows external genitalia normal, except for the sparse growth of pubic hair. Examination of the internal genitalia discloses an infantile uterus.

Roentgen-ray study fails to demonstrate the presence of the thymus gland, nor does it show any changes in the long bones or their epiphyses, or the bones of the hand or wrist. The sella turcica was reported as "within normal limits in size." The

* In a report of these same patients, read before the Oxford Congress of Ophthalmology in July, 1924, by Dr. Hansell, he makes the suggestion that a better term than retinitis pigmentosa for this condition would be "optic nerve and retinal atrophy associated with pigment filtration," as being more nearly descriptive of the clinical and pathological process. W. H. Wilmer (Arch. Neurol. and Psychiat., 1924, xii, 137), in a paper entitled "Hereditary Factors in Optic Atrophy and Retinitis Pigmentosa" suggests the term "pigmentary degeneration of the retina;" or would accept Collins's suggestion of "abiotrophy of the retinal neuro-epithelium," perhaps simplified as "retinal abiotrophy." ("Abiotrophy," a term introduced by Gowers, is defined by Collins as "The premature failure of the inherent vitality of a tissue, giving rise to impairment or destruction of certain functions before the death of the organism as a whole.")

dorsum is perhaps somewhat higher than common. Our general observation however, and the careful studies of Schaeffer and de Schweinitz reported in the latter's Bowman Lecture, make us chary of drawing conclusions from sellar shadows.

Pituitary and thyroid therapy produced no change in weight, in mentality or in temperament. The girl said she "saw better," but there was no objective confirmation of this, and suggestion was not absent. Moreover, there was hospital care and rest as a general upbuilding influence. The menses appeared for four days in February, 1924 (nine months after the previous menstruation), and again in March and April. This seemed, at least, to be the result of the endocrine therapy.

Case II.—Nicholas (Fig. 2), aged twenty-one years, the oldest of the abnormal children, is very much like the girl just described. He is a big laughing boy, with high color and a sparse growth of hair in the beard region. He weighed 221½ pounds and measured 160 cm. in height; 78 cm. from the symphysis to sole, and 88 cem. from symphysis to vertex. His span was 159 cm.

At birth he seemed a normal child, except for six toes on the right foot. Dentition began at six months, and he began to walk when one year, and to talk when two years, of age. He had measles and scarlet fever in childhood, from both of which he made good recovery, and he has not been sick in bed since. He says, and his parents affirm, that he has been fat all his life. At the age of sixteen years he noticed some failure of sight, and this has grown progressively worse. He works as a newsboy at night, making his way to and from his stand with great difficulty, on account of his poor vision. Otherwise he is in excellent health.

Physical examination reveals *adiposity* chiefly of the mammary, mons and girdle type. He has some degree of genuvalgum. His hair is black, coarse and thick. The eyes are almost constantly moving, the nose is small, the ears are thick and set close to the head, the teeth are good, the palate is high arched and the tonsils are large. The back of the head is straight with the neck, which is short and thick. The *thyroid gland* is palpable, but not enlarged.

The heart and lungs are normal; abdominal examination is negative. The axillary hair is rather sparse; pubic hair is about normal in amount and distribution. The penis is very small; the testes, however, seem normal in size. The hands and feet are broad and thick. There is no adenopathy, and the reflexes are normal. He, too is *mentally* deficient, but seems more intelligent than his sister. He counts in "twos," probably because his papers sell for two

Fig. 2

cents each. He is of a very merry disposition, is easily amused and laughs readily.

The *eye report* is as follows: "Highly myopic and astigmatic; night blindness, increasing each year. There is a rapid, jerky vertical and rotary nystagmus, augmented by attempts to see objects held close to the eyes. The optic nerves are atrophic; the arteries and veins are reduced markedly in size. Pigment spots

and a few 'bone corpuscles' are scattered throughout the fundi. The fields are limited to a small area around the fixation point. Convergence is deficient. Pupils are equal and react." (Hansell.)

Laboratory studies are as indicated in the accompanying chart which gives the principal data of our records arranged in tabular form. Basal metabolism was normal; sugar tolerance slightly reduced.

TABULATION OF THE PRINCIPAL DATA OF OUR RECORDS.

	Nicholas, 21 yrs.	Catherine, 17 yrs.	Anna, 15 yrs.	Joseph, 11 yrs.
Dentition	5–6 mos.	5–6 mos.	6–7 mos.	6–7 mos.
Walking	12 mos.	12 mos.	16 mos.	11 mos.
Talking	2 yrs.	1½ yrs.	2 yrs.	15 mos.
Poor vision noticed	16 yrs.	15 yrs.	13 yrs.	10 yrs.
Present weight, pounds	221½	152	121	110
Height, cm.	160	144	136	136.5
Span, cm.	159	142	138½	129
Symphysis to sole, cm.	78	70	67	65
Symphysis to vertex, cm.	82	74	69	71.5
Temperature, pulse and respiration	Normal	Normal	Normal	Normal
Urinalysis	Negative	Negative	Negative	Negative
24-hr. houtput, cc	900–1000	1000	800	100
Blood-pressure	130/90	110/70	120/85	110/60
Blood count	Normal	Secondary anemia	Normal	Normal
Wassermann	Negative	Negative	Negative	Negative
Basal metabolism	−3	−19	−29	−21
Sugar tolerance 1.75 gm. per kilo body weight:				
Before, per cent	0.118	0.098	0.116	0.101
½ hour	0.246	0.176	...	0.166
1 hour	0.268	0.199	0.190	0.125
2 hours	0.163	0.202	0.135	0.109

Roentgen-ray studies show normal long bones, wrist and hand; the sella turcica is reported as "slightly smaller than the average." The posterior clinoid is high. No thymus shadow can be made out. Endocrine therapy, pituitary and thyroid, over a period of eight months, has had no apparent effect on this boy.

Case III (Fig. 3).—Anna, aged fifteen years, is a dull-looking shy girl, excessively developed for her age. She weighed 121 pounds. She measured 136 cm. in height, 67 cm. from symphysis to sole and 69 cm. from symphysis to vertex; her span was 138½ cm.

She appeared to be a normal child at birth. Unlike the two whose histories have been detailed, she did not have an extra toe. Dentition occurred normally; walking and talking were somewhat delayed. She had measles, but made a good recovery, and has had no other illness. Her general health has been excellent. Dimness of vision was first discovered at about the age of thirteen years; it was noticed in school that she could not follow a straight

Fig. 3

line in writing. Menstruation began when fourteen years of age, and has always been regular.

Physical examination: Her *adiposity* is of the girdle, mons and mammary type; the mammæ are especially large. Her hair is straight, black and coarse; the teeth are normal; the palate is high and narrow; the tonsils are large. The *thyroid gland* is palpable, but not enlarged. Heart and lungs are normal; there is no aden-

opathy, and the reflexes are normal. The external *genitalia* are normal, but rectal examination discloses an infantile uterus. This child, too, is deficient *mentally*, but does not seem to share in the exceptionally happy disposition shown by Nicholas and Catherine. Allowing for her mental hebetude, however, her mirth reactions seem about normal.

Roentgen-ray study of the sella turcica shows "floor rather uneven and posterior clinoid process inclined slightly backward." No thymus shadow can be made out. Roentgen ray of the long bones, wrist and hand is normal.

Laboratory examination: A sugar-tolerance test showed a slight deficiency in her ability to handle glucose. The basal metabolism was − 29.

The *eye report* shows: "Media clear; numerous round, pigmented spots throughout the peripheral retina. The nerve is of fairly good color; the vessels are contracted. There is partial optic nerve and retinal atrophy. The fields are concentrically contracted. Diagnosis, early retinitis pigmentosa." (Hansell.)

Hormone therapy seemed without effect on this girl.

Case IV (Fig. 4).—Joseph, aged eleven years, the youngest of the abnormal children, is a dull-looking, fat boy, very much like the others. He weighed 110 pounds. He measured 136 cm. in height; his span was 129 cm.; from symphysis to sole he measured 65 cm., and from symphysis to vertex 71½ cm.

He was apparently a normal infant (no extra toes); dentition, walking and talking occurred at the common times. He had diphtheria at the age of ten years, and made a good recovery. Otherwise he has always been in good health. His dimness of vision, like his sister Anna's, became noticeable in school about one year ago, when he experienced considerable difficulty in reading and writing. Like Anna, he is *mentally* deficient, without marked euphoria.

Physical examination shows an obese boy, with *adiposity* a little more marked in the girdle, mons and mammary regions. Like the other children, he has a high-arched palate and enlarged tonsils.

His hands and feet are thick and chubby. *Genital* development seems fair for a boy of his age. There is a moderate degree of phimosis.

Eye examination shows the following: "A decided optic nerve and retinal atrophy. There are a few pigmented spots scattered throughout the periphery of each fundus. No myopia; no nystagmus. Patient too stupid to take visual fields. Diagnosis, atypical retinitis pigmentosa." (Hansell.)

Fig. 4

Roentgen-ray study of the sella turcica, thymus and bones revealed nothing abnormal.

In *laboratory study,* reaction to sugar-tolerance tests was normal; basal metabolism, − 21.

Hormone therapy seemed without effect.

Summary of Cases. Four of 8 brothers and sisters of Italian parentage, exhibit marked adiposity with mental deficiency, genital dystrophy and diminution of vision. Two of the abnormal children show polydactylism. The eye-grounds (H. F. Hansell) show atypical retinitis pigmentosa. The fat distribution is largely of the girdle, mons and mammary type. An hypophyseal lesion cannot be proved. Roentgen-ray examinations of the sella region do not show conclusive changes. No anomaly of osseous development is found. Sugar-tolerance tests do not indicate pituitary disease. Basal metabolism was below normal in 3 of the children. Both parents and children gave negative Wassermann reactions. The thyroid glands are palpable and within ordinary limits of size and consistence. There is no lymphadenopathy, and no history of rickets.

Family history of marked adiposity, visual defect, polydactylism, deafness or idiocy could not be obtained. The four unaffected children seem entirely normal; one indeed, is uncommonly bright and active. Hormone therapy (pituitary—thyroid) seems to correct amenorrhea in the older girl, but otherwise was without effect on any of the children. Subjective improvement in the sight of the elder girl may have been the result of hormone therapy, but may with equal probability be referred to suggestion, or to the general improvement of nutrition attending hospital care.

Review of Similar Cases. A survey of the literature of retinitis pigmentosa brought out the following remarkably similar group reported by J. Z. Laurence and R. C. Moon, in 1866, under the title, "Four Cases of Retinitis Pigmentosa Occurring in the Same Family, Accompanied by General Imperfections of Development."[1] These authors describe the case of Marian T., aged seven years, 3 feet 8 inches in height, a flat-featured, heavy looking child with light auburn hair and gray irides. Her sight had been defective for two years. There was night blindness and slight lateral oscillation of each eye, combined with a very imperfect power of fixation. Ophthalmological examination revealed retinitis pigmentosa.

No hereditary tendency could be traced, nor were the parents

related by blood. There had been 10 children in all; 2 died in infancy, 1 of smallpox and the other of consumption. Both the father and mother were active, intelligent and well built, with no imperfection in sight. The following description of the children was given by the parents:

"Richard, aged twenty-four years, a fine young man, healthy in every respect.

Arthur, aged twenty-two and a half years, also a fine young man, healthy in every respect.

Harry, aged twenty years, *afflicted*, and has bad sight.

Ferdinand, aged eighteen years, *afflicted*, and has bad sight.

Charles, aged fifteen years, *afflicted*, and has bad sight.

Edwin, aged thirteen years, healthy in every respect, and very sharp at learning.

Willie, aged nine years, healthy in every respect.

Marian, aged seven years, a very quiet, slow child, *afflicted*, with bad sight."

To this, the authors of the report add their observations, which we give in abstract:

Harry, aged twenty years, is short for his age, measuring 5 feet, 3½ inches. He walks with a slouching gait, "as if he were tipsy," and appears to have hardly sufficient power to drag his legs; there is a rather deep depression between the scapulæ. The curve of the lumbar vertebræ, however, is very considerable, causing the trunk to be thrown forward from the hips and the buttocks to be more prominent than usual. The lower extremities are short and the muscles flabby. He has a stolid, heavy countenance, and appears to be rather obtuse and unintelligent. He answers questions slowly, but with tolerable accuracy.

Eye examination shows the power of fixation imperfect and the eyes rather continuously moving from side to side. The eye-grounds show retinitis pigmentosa.

Ferdinand, aged eighteen years, is 4 feet 6½ inches tall. He is a fat, heavy-looking boy, and, like Harry, he walks with a slouching heavy gait, dragging his legs from the hips. Eye-sight was first noticed to be defective at the age of six or seven; it has

become progressively worse ever since. Eye examination shows retinitis pigmentosa.

Charles, aged fifteen years, is 4 feet 4 inches tall. He is dull and inanimate, and walks with a slouching gait, but not to the same extent as his two brothers. Sight has been defective since one year of age. Eye examination shows retinitis pigmentosa.

The organs of regeneration are also strikingly implicated in the general want of development. There are no signs of rickets, scrofula or syphilis.

We quote the closing paragraph of this noteworthy and philosophical report. (The italics are ours.)

"In calling these cases by the name of retinitis pigmentosa, we have been guided by usage rather than by the intimate nature of the cases. Had we taken the latter view, we would rather have entitled our paper, 'Four Cases of Arrest of Development and Atrophy of the Eye,' or we might even *have gone a step further in the generalization of our title, as the arrest of development was by no means confined to the eye,* but affected several other organs of the body. In this latter point of view, and more especially when we regard the mental faculties, these patients may in a certain sense be *compared with cretins* in a mild degree. In no member of the entire family was there any bronchocele."

Summary of Remarkably Similar Family Group Reported by Laurence and Moon in 1866. Four of 8 brothers and sisters of healthy parents, showed retinitis pigmentosa, adiposity, genital dystrophy and mental deficiency. Three of these likewise showed imperfections of bony and muscular development leading to defective gait. There was no sign of rickets, of scrofula or of syphilis. The authors recognized that the retinal changes were but part of a general developmental failure and that, especially in view of the mental condition, these persons could be, not inaptly, compared to cretins.

Similar Cases Recognized as a Syndrome by Biedl. Raab, in the course of a very careful study from Biedl's Clinic, emphasizes the occurrence of "a syndrome, perhaps familial, hitherto scarcely known, of (1) optic atrophy with pigmentary degenera-

tion similar to retinitis pigmentosa, (2) polydactylism, (3) obesity and (4) genital hypoplasia." Except for its failure to include mental deficiency, this description runs on all fours with our cases, and fairly with those cited from Laurence and Moon. Biedl, however, when in Philadelphia in the spring of 1924, saw our patients, and in confirming our opinion of the identity of the syndrome with that which he had described, included the mental phenomena. Indeed, he laid stress on this feature as evidence of a cerebral, rather than a hypophyseal origin of the disorder. We accordingly propose to call it the Laurence-Moon-Biedl syndrome, in acknowledgment of its original observers and of its rediscoverer.

Biedl's cases, reported in abstract in 1922,[2] are recorded in detail by Raab.[3]

Biedl's Cases. The family history was negative. The mother had 6 normal births and 1 miscarriage. The order of births was as follows:

Girl, aged twenty-two years, first born, *affected.*
Boy, had *polydactylism;* died at age of two years, of pertussis.
Girl, had *polydactylism;* died at age of three weeks.
Boy, normal; died at age of nine months.
Boy, aged sixteen years, *affected.*
Boy, aged fourteen years, normal.

Case I.—A girl, aged twenty-two years, was a stout child. She has had poor vision in twilight since childhood, and in the last year she has had marked diminution of vision. Obesity has increased since the age of sixteen years. Menstruation began at twenty-one years; the flow was scanty and irregular, appearing only four times, and has not appeared for one year. She has a wide head, and the head and neck are vertical. The hair on the head is coarse, and there is some hair on the cheeks, chin and upper lip. Axillary hair growth is poor, but there is considerable hair over the pubic region, distributed in masculine fashion. The skin is rough and dry, the face ruddy, and the skin of the chest and extremities is mottled. There is adiposity, especially of the

breasts, abdomen (limited by a deep furrow at the mons pubis) and hips. The thighs are massive, but the extremities otherwise are less involved in the adiposity. The hands are short, the joints wide, and the fingers end in knobs. The feet are short and broad and there is genuvalgum of a moderate degree. There is an extra toe on the outer side of the left foot, and syndactylism between the second and third toes of the right foot.

The eyes show a slight divergent strabismus; pupils react poorly to light and convergence. The eye-grounds show retinitis pigmentosa with very little pigment. The vessels in the papillæ are narrow and there is slight sclerosis of the vessels of the choroid. There is a postcortical cataract and marked limitation of visual fields. Vision: O. D., counts fingers at 15 cm; O. S., counts fingers at 30 cm.

Teeth are partly defective; thyroid negative; mammæ very obese, nipples without pigment.

Genitalia: Labia majora flat, clitoris small, prepuce hardly apparent, the hymen fleshy. By rectal examination the vagina is found to be short, the uterus small and inclined backward, and the adnexa not palpable.

Roentgen-ray of the skull shows a moderate degree of brachycephaly, with occiput sheer. The sella turcica is small in width and configuration. The dorsum sella is plump and sheer.

Urine examination is negative; blood count is normal; Wassermann reaction negative.

There is mental torpor and a phlegmatic lack of interest. Menses occurred after administration of ovarian substance, and then continued without further therapy. Sometimes they were substituted, and always accompanied, by nasal bleeding and headache.

The vision gradually improved under combined pituitary and thyroid therapy, and a gradual loss of weight amounting to 6 kg. occurred.

Case II.—Ernest, aged sixteen years, weighs 54 kg. and measures 141 cm. in height. He has been fat since childhood, and has

had defective sight. He is brachycephalic and his occiput is sheer. His hair is dense and coarse; cheeks are red; palpebral fissures narrow; nose short; eyebrows almost absent. He has very little hair on the body. His skin is dry, rough and cold, and over the throax and extremities is mottled. There is marked adiposity, especially of the mammæ; and the lower extremities are fatter than his sister's. The legs are column-like, the hands short and the joints broad; the fingers are thick at the base, the tips pointed. There is a sixth finger on each hand. There is slight genuvalgum. The feet are short and broad, and there are six toes on each foot.

Eyes: Pupils react to light and accommodation; there is an *atypical retinitis pigmentosa*. The vessels are broad, and there is abundant pigment; there is postcortical cataract; marked limitation of visual fields; marked diminution of vision. The oral opening is narrow, the teeth good; the thyroid is normal; thorax is short and barrel-shaped; heart and lungs are normal; the mammæ are fatty, the nipples free of pigment. The abdomen is negative.

Genitalia: Scanty hair; there is a cushion-like, overhanging mons veneris and a nipple-like penis; the scrotum is divided into halves by a deep raphé; the testes are the size of beans; the prostate is not palpable.

Roentgen-ray of the skull shows moderate brachycephaly, a sheer occiput, and no evidence of increased intracranial pressure. The sella turcica is of normal width and configuration; the dorsum sellæ is plump and sheer.

Urine and blood examinations are negative; Wassermann reaction is negative.

Mentally the boy is childish and apathetic.

A third case, occurring in another family was likewise reported by Biedl:

A boy, aged thirteen years, showed adiposity (weight 66 kg.) and retinitis pigmentosa. The family history was negative.

Roentgen ray of the skull showed a thick and plump dorsum sellæ.

Summary of Biedl's Cases. A brother and sister, of a family of 6 living boys and girls of healthy parents, show atypical retinitis pigmentosa, adiposity, genital dystrophy, polydactylism and mental deficiency. Two others of the family who died in infancy showed polydactylism. (Assuming that these might have developed the full syndrome had they lived, we have the remarkable parallel of 4 healthy and 4 affected children in this group, as in Laurence's and in ours.)

Roentgen ray of the skulls of the abnormal children showed no definite lesion of the sella turcica, but the dorsum sellæ were plump and sheer. The same was true of a third case occurring in another family. The brother and sister appeared to respond to hormone therapy.

Biedl regards the condition as a distinct syndrome.

Raab's paper, entitled "A Clinical and Roentgenologic Study of Hypophyseal and Cerebral Obesity and Genital Atrophy,"[3] deals with this particular syndrome (of which he states there are seven certain cases*) only as a part of a larger consideration of dystrophia adiposogenitalis. This he believes is not an unvarying condition, but has as its chief components obesity and genital atrophy or genital hypoplasia. His views, based upon the teaching of Biedl,† may thus be summarized:

In studying the genesis of dystrophia adiposogenitalis it is necessary to take into account the function of the hypophysis. Under normal circumstances the pars intermedia furnishes a secretion which is led off by the posterior lobe and stalk to energize certain metabolic and genitotrophic centers lying at the floor of the midbrain (hypothalamic centers). If by reason of some abnormality, developmental or acquired, this secretion fails (*a*) to reach, or (*b*) to energize these centers, some form of dystrophia adiposogenitalis or of cerebral adiposity will result. There are thus three

* He does not know of de Schweinitz's cases, of Engelbach's cases, of Laurence and Moon's cases, or of our cases. These bring the record, so far as known to us, up to 20 in all.

† No attempt has been made to preserve in this summary either the author's language or his method of statement.

classes of disorder, according as (*a*) there is disease or defect of the hypophysis (pars intermedia), (*b*) obstruction of the pathway and (*c*) disease or defect of the cerebral centers. For example, tumors within the hypophysis causing injury to the middle and posterior lobes may give rise to the clinical picture from failure of secretion; as may tumors without, from obstruction of the pathway. Internal hydrocephalus may cause the syndrome by pressure on the hypophysis or by obstruction of the pathway, or by direct injury to the basal centers. Lesions or defects of the trophic centers themselves may bring about the symptoms, independently of hypophyseal failure, direct (structural or functional) or indirect (obstruction). Among such cerebral lesions could be: Encephalitic foci, tumors, tuberculosis or syphilis of the base of the brain, traumatism; the defects might be functional failures from acquired disease or disorder, or congenital abnormalities.

The *hereditary* (familial) occurrence of the syndrome may be occasioned by congenital hypoplasia of the hypophysis, by internal hydrocephalus and by anomalies of the skull, such as an abnormally high or massive dorsum sellæ. It will be recalled that in the particular syndrome of which we speak, Biedl stressed the importance of the last factor, that is, the high or massive dorsum sellæ, and Raab reëchoes the emphasis laid upon it as a mechanical element in this congenital form of cerebral obesity. He believes that the skeletal defects, polydactylism, and a high and perpendicular dorsum sellæ are similar anomalies, and that the sellar obstruction stands in direct causal relationship with the adiposity and genital dystrophy. Thus the thicker and more perpendicular the dorsum, and the more extended its contact with the third ventricle, the more likely is the syndrome to develop. He believes that pressure occurs at the edge of the dorsum, thus shutting off from the basal centers the energizing secretion of the middle lobe of the hypophysis.

G. E. de Schweinitz, in his Bowman Lecture,[4] speaks briefly of the association of pigmentary degeneration of the retina with pituitary diseases and polydactylism. After citing a case of Bardet's published in a thesis of 1920 (and which is abstracted

and included by Raab in cases from literature) he mentions 3 cases of this character that he himself, has seen. One responded well to organotherapy—vision, general condition and mentality showed distinct improvement; in another the effect seemed favorable, but not so pronounced. He suggests that subjects of pigmentary degeneration of the retina who are benefited by the administration of pituitary and thyroid extracts may owe their improvement to the corrective influence of these preparations upon an associated pituitary-body disorder.

Discussion. That the retinal phenomena of the syndrome described by Laurence and subsequent writers and which the cases here reported well illustrate, represent merely one phase of a general developmental failure, seems self-evident, and we need not stress the point further. Retinitis pigmentosa—to use the common term—has a very definite hereditary transmission, is often accompanied by nystagmus, strabismus, deafness, hare-lip, supernumerary toes and fingers and other anomalies; but its particular association with this form of dystrophia adiposo-genitalis stands out as a distinct syndrome.*

For the sake of discussion let us accept Biedl's thesis in regard to the cause of cerebral obesity. He contends, it will be recalled, that the secretion furnished by the pars intermedia of the pituitary gland is led off through the posterior lobe and stalk to energize the centers regulating metabolism and genital growth, which are situated at the floor of the midbrain. If (*a*) this secretion fail to reach the centers, or (*b*) if it be lacking, defective or perverted, or (*c*) if the centers themselves, being defective or diseased, fail

* Thus Stör (Klin. Monatsbl. Augenh., 1865, p. 23; as cited Brit. Oph. Rev., 1866, ii, 203), reporting on a patient with hemeralopia, six digits to each extremity, and mental retardation, does not mention adiposity or defect of the genitals. Nor does Höring (Klin. Monatsbl. f. Augenh., 1865, p. 236; cited Brit. Oph. Rev., 1866, ii, 408), who found 4 cases of retinitis pigmentosa among 31 defective children in the institution at Stettern, examined with special reference to the ocular affection, mention these conditions. According to Nettleship (Trans. Oph. Soc. United Kingdom, 1909, xxix, 37), progressive nerve deafness and idiocy seem capable of acting as mutual equivalents or substitutes in hereditary transmission of the complex associated with retinitis pigmentosa.

to react normally to the secretion, dystrophia adiposogenitalis will result.

We are then left with several possibilities as to the cause and pathological mechanism of this particular syndrome, which is unquestionably of congenital origin. Among such possibilities are congenital hypoplasia of the hypophysis, a high dorsum sellæ obstructing the pathway and congenital defects of the midbrain.

Engelbach,* who has seen, but not reported, two cases of this syndrome, has been rather in favor of the pituitary origin of so-called cerebral obesities in general; but perhaps the strongest point against direct pituitary genesis of the syndrome presented in our cases is the normal osseous development, the significance of which Engelbach† himself has specially emphasized.

Our own first tendency in regard to our patients was, indeed, to imagine, in spite of the inconclusive roentgen-ray studies, a congenitally deficient hypophysis. Reflection, while leading us to admit the weight of evidence against this view and in favor of congenital defect of the trophic centers, inclines us, nevertheless, to keep our minds entirely open and await the progress of research. The hypothesis advanced by Biedl and elaborated by Raab is more than highly plausible—it is seductive. But as yet there is no proof from necropsy that in cases like those here reported the hypophysis is not involved in the general imperfection of development. Hence, while we wish to go on record as to the disinctiveness of the syndrome as a pathological entity and the strong possibility of its cerebral origin, we are content to leave the question of the exact mechanism to further study.

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* Personal communication to one of us (S. S.-C.).

† In a recent communication Engelbach and McMahon[5] suggested, after a comparative study by roentgen ray of the development of the bones in normal persons and in those subject to endocrine disorders, that the information thus gained may be of more value in diagnosis than basal metabolism, blood chemistry and other so-called specific and laboratory determinations.

DISCUSSION

Dr. Howard F. Hansell: The ophthalmoscope picture of retinitis pigmentosa, namely, atrophy of the optic nerve with diminution in size, both of caliber and length, of retinal arteries and veins, heaping of so-called "bone cells" throughout the periphery of the fundus and extending in advanced cases as far as the posterior pole, represents the typical retinitis pigmentosa and is well illustrated in Yaeger's original colored sketch which for the past fifty years has been reproduced in the text-books. Yet there is one other clinical variety—and one which is far from frequently found—called for lack of a better name "atypical." This includes several types. It is probable that the pathologic process is not essentially dissimilar in the different varieties. The participation of the choroid, although denied by some writers, seems to be generally admitted, and consists of thickening of the walls of the large and small choroidal vessels, pigment heapings or atrophic patches, atrophy of the choroid capillaries, infiltration of the round epithelioid cells in patches and retinochoroidal adhesions. The retinal changes are hyperplasia of the connective tissue, sclerosis of the vessel walls with narrowing of the caliber, changes in the pigment cells, partly hypertrophy, partly atrophy, filtration of pigment cells into the retina, especially along the vessel walls, and atrophy of the nerve elements. The choroidal changes are secondary to those in the retina and morbid process in the retina, a part of the degeneration of the nerve fibers in both optic nerves and retina which may be considered to be the primary ocular affection. More stress appears to have been laid on the pigment changes in the retina than the morbid process in the nerve, and yet they are only part of the ophthalmic picture. Indeed, it would seem, since the eye changes are so constantly associated with bodily defects—hereditary, congenital and acquired—the nervous system may be the primary cause atrophic, as are also the optic nerve fibers in the retina. The gradual destruction of the nerve elements is constant, the retinal pigment changes are variable, one is inclined to believe that the disease is fundamentally one of the cerebrospinal nervous system and that the eye signs and the associated bodily and mental abnormalities make up the symptom-complex.

Dr. Francis X. Dercum: I had the great pleasure of examining Dr. Cohen's cases and also heard the interesting discourse of Dr. Biedl at the College last year. Great caution should, however, be exercised, I think, in drawing inferences as to the activity of the pituitary gland from the x-ray pictures presented by the sella turcica. In dystrophia adiposo-

genitalis the pituitary gland—contrary to the findings in Dr. Cohen's cases—is greatly enlarged. This enlargement, however, is not due to a hypertrophy of the constituent portions of the gland, but due to a destruction of the latter by a tumor formation. In Dr. Cohen's cases the pituitary fossa is very small. Further, whether we look upon the resulting dystrophy as due to a failure of the pituitary secretion to reach the nuclear aggregations supposed to exist in the floor of the hypothalamus and which are supposed to be concerned in metabolism, or whether we regard the resulting dystrophy to result from the failure of these nuclear aggregations to act on the endocrines and other viscera, one fact and one fact only, presents itself as a justifiable inference, namely, that we are dealing with a pituitary failure, *i. e.*, a hypopituitarism.

Now, as I have pointed out in my recent book on the biology of the internal secretions, the various glands of internal secretion, exclusive of those concerned in reproduction, are associated physiologically into two distinct groups. The first group is concerned with constructive metabolism—that is, with storing up and conservation of energy. It is made up primarily of the pancreas, the thymus and the parathyroids. Other great glands and viscera such as the liver, the glandular adnexa of the alimentary tract and possibly the great blood-making organs such as the spleen should be added to this group. The second group is concerned with the elimination of energy, *i. e.*, with catabolic processes. It is made up of the thyroid, the pituitary and the medulla of the adrenals or the chromaffin system. The action of these two groups is diametrically opposed; one is, so to speak, anabolic in its action the other catabolic. There is, therefore, an antagonism between the two groups which results in a mutual inhibition. Upon this mutual inhibition depends the proper balance of metabolism in the organism. If one group fails in its action the other group undergoes a corresponding exaggeration of its function. It is this factor which must be taken into account in interpreting the obesity in Dr. Cohen's cases. The pituitary and the pancreas, for instance, belong to antagonistic groups. Further, there are special reasons which I cannot go into now, for inferring the existence of a special antagonism between the anterior lobe of the pituitary and the pancreas. If this be true the adiposity presented in cases of pituitary failure is to be looked upon as due to an abnormal rise in the function of the pancreas, namely, as the result of a hyperpancreatism. In other words, carbohydrate metabolism has been enormously increased with adiposity naturally resulting.

The factor of retinitis pigmentosa present in Dr. Cohen's cases is in my judgment merely to be regarded as an associated nervous or neuron degeneration having merely the significance of the general biologic failure

present in these cases. This interpretation is rendered the more probable when we reflect that the nervous affections and nervous factors generally met with in retinitis pigmentosa vary very greatly. Thus we find that in retinitis pigmentosa there is frequently a history of nervous diseases in the ancestry, such as epilepsy. Consanguinity of parents also is said to occur in about one-third of the cases; it is absent in the present cases. The familial occurrence of retinitis pigmentosa is not infrequent.

Very often it is found associated with other nervous affections; these are numerous and varied. For example, Wilbrand and Saenger, Leber, Jendrassik and others have noted, among other things: General retardation of the physical development; failure of full development of the extremities, polydactyly, talipes varus, harelip, microcephaly, idiocy, epilepsy, mental subnormality, deafmutism, speech disturbances. Various anomalies of the eyes such as microphthalmus, keratoconus, persistent hyaloid artery, dislocation of the lens, high-grade myopia, strabismus and nystagmus have also been noted. I should add that I have recently studied two brothers suffering from retinitis pigmentosa in which there were present also degenerative changes in the extrapyramidal pathways. Such a great variety in the nervous affections met with in retinitis pigmentosa forbids us to assign to any of them a special value or significance. Taken separately or in their entirety they have merely the meaning, as just stated, of a general biologic failure.

Dr. George E. de Schweinitz: Among the extraocular complications of pigmentary degeneration of the retina polydactylism has long been known and is not very uncommon. But a syndrome characterized by congenital malformations (atresia ani, polydactylism, so-called retinitis pigmentosa); deformities of the skull; retarded mental development; obesity with or without genital hypoplasia; and peculiar digestive disturbances; diabetes being an occasional concomitant symptom is less familiar, although originally recognized a good many years ago. Recently this syndrome has attracted renewed attention and we are indebted to the essayist of the evening for an excellent portrayal of this subject.

In an experience with something over a hundred of various types of pituitary body dysfunction, several patients belonging to this class have been observed and 3 of them have been studied with reasonable accuracy—2 girls and 1 boy. In 1 case it has been possible to follow the course of events from the time the child was two and a half years of age until the present date, when she is thirteen years of age. All of these patients had in addition to polydactylism and pigmentary degeneration of the retina decided general symptoms of pituitary dysfunction.

In the case history of 1 of these patients there is somewhat uncertain

evidence of consanguinity of the parents; in the other 2 this factor is wanting. Heredity and syphilis as etiologic influences may be dismissed. In 1 of the patients (Case I) defective vision was not noticeable until after the fifth year; in another (Case II) the date of its onset was not ascertained; and in the third it began very early—during the first few months of life. The general effects of pituitary disorder appear to have manifested themselves as early as the eleventh month, or even earlier in 1 of these patients (Case III), in another (Case I) at some period between the fifth and the seventh year and in the third probably quite early in life, but the history is uncertain.

As to the types which these 3 patients portray, 1 was small in stature (moderate dwarfism until she was nine years of age), with adiposity, but mentally alert; 1 obese, with facial expression suggestion the Mongolian type, or, more exactly, the girl has a very large abdomen, flat thorax, large buttocks and hips, very large lower limbs, thin, elongated fingers, flat head, narrow forehead and broad-bridged nose; she is mentally backward. None of these patients had genital hypoplasia. Two of them have had chorea or choreiform movements; and 1 was very large and fat (285 pounds), of the acromegalic type and mentally only tolerable. One (Case II) reponded well to organotherapy, vision, general condition and mentality, showing distinct improvement, and 1 (Case I), since glandular feeding has been pushed, has maintained vision, which previously was rapidly declining; no effect noted in Case III, but it is doubtful if he continued the medication.

As is well known, in recent years thyroid extract, or it and pituitary gland extract combined, have been advocated as remedial agents in pigmentary degeneration of the retina, and encouraging results have been reported. In my experience, although largely employed, these remedies have been valueless in ordinary types of this disease. But their influence in Case II was favorable and apparently moderately advantageous in Case I of the present series. It is possible, therefore, that the subjects of pigmentary degeneration of the retina who are benefited by the administration of these extracts may owe their improvement to an associated pituitary body disorder.

A few lantern slides may be interesting, in that they portray one of the patients from the age of two and a half to thirteen years.

Dr. Cohen (closing): In regard to endocrine therapy there is so much guesswork that one must not be too positive in any statement; nevertheless, there is some probability in certain conclusions. In this particular group of cases—these four individuals described—both thyroid and pituitary preparations were administered in rather a careful way, partly

as legitimate therapeutic experiments, partly as possible diagnostic aids. As stated in the paper we failed to observe any definite benefit of any kind. One of the girls said that she "saw better," but there was no objective proof. I am inclined to believe that the feeling of betterment was a psychic result of the attention paid to her. At all events I could not convince myself that there was any direct benefit from endocrine therapy. It has occurred to me, however, that we might with safety and propriety go a little further. I have not as yet done so, but it might be a legitimate therapeutic experiment to try the influence of pineal gland. It will be remembered that Descartes, following Arabian physiologists and philosophers, thought the pineal gland was the seat of the psyche or soul. Some modern medical philosphers teach—I do not accept the teaching—that all psychological phenomena are dependent on sex. However, this may be the pineal gland does influence sexual development. With its hypertrophy a like hypertrophy or very early maturity of the gonads has been observed. It is worth while to consider whether, in the youngest of the children, at a time when one may suppose that he is still susceptible to pineal influence, the observation might not properly be made.

As concerns the shape and depth of the sella, one is left, after reading de Schweinitz's Bowman lecture, in a state of almost complete skepticism as to the value of x-ray determination. Perhaps Biedl and Raab are right. I admit that their view is fascinating—which is far from being fantastic. They have given very careful study to the matter of configuration of the sella, and it may be that either congenital or acquired peculiarities thereof play an essential part in the mechanism of abnormal adiposity and genital dystrophy. I must wait, however, for greater light upon the rôle of the hypothalamic centers in normal development and upon the influence of the pars intermedia upon these centers before coming to a definite conclusion.

Dr. Dercum has opened a very big topic which one cannot now discuss at length. But one point may be emphasized. We have to consider the human body as a whole. We study its parts so much and in such detail that we may lose sight of the forest not only because of the trees, but perhaps because of the leaves of the trees and the nuts on the ground. We have again to recognize that there is such a thing as a soma—a functioning whole. Originally the single cell performed every function; there was nothing necessary to life that it could not do; but by degrees the individual cells surrendered a part of their independence and came more and more under the rule of the general organism. I believe the animal body very much resembles the body politic; that we have municipalities and states and federations of states, and then perhaps a federation of the federations; and we have, as the coördinating and governing mechanism,

the autonomic-endocrine system which must be considered as an organic whole. Unless we take into consideration the autonomic—the so-called vegetative or involuntary functions—as a whole we cannot understand any single case of disease, to say nothing of these puzzling congenital maldevelopments. Now it has seemed to me—I may be going too far into speculation here, but one has to speculate when knowledge is imperfect—as if the central nervous system, being unable to reach out to all the different independent cells with its fibers, has established relay stations in the so-called endocrine bodies, where the nerve impulse—probably an electric phenomenon—is translated into a chemical impulse; and the resulting chemical message—the hormone—sent to the cells to control their nutrition, their development and their special function. Such impulses may originate peripherally or centrally—directly or by reflex—but they must in final analysis be subject to central regulation. The hypothalamic centers may be—and some recent experiments tend to indicate they are—of considerable importance in this coördination and regulation. Thus we come back to the question of the relation between the great involuntary nervous system, the endocrine bodies and the peripheral cells. As Dr. Dercum has pointed out, these relations can be separated into categories and studied. Especially is the balance of function to be observed. Perhaps by the eventual coördination of clinic and experiment and postmortem study, definite knowledge may be attained. Meanwhile, in our practical work, we have to remember that the human body is a complex chemical engine—or let us say an electrochemical engine—regulated by electrical, chemical and mechanical devices; that each part and each function is intimately connected and related with every other part and every other function, and also with the soma—the organism as a whole; and that the directive influence of the soma is necessarily localized in centers and subcenters. Neglect of the communicating and governing system whereby the normal relationships—constituting the balance of function—are maintained or restored must prevent a correct understanding, even of our ordinary bedside problems; and certainly prevents a comprehensive view of disorders directly dependent on failure or lesion, peripheral or central, of that system itself—the autonomic-endocrine system.

Dr. Dercum: Inferences in regard to the growth or development of the pituitary being hampered, restrained or interfered with by the sella turcica, or indeed any portion of the cranium, I regard as fallacious, for the cranium primarily is molded upon its contents. It is the latter which determines the size and shape of any portion of it. In the embryo and in the fetus the cartilaginous structure of the basisphenoid is soft and yielding; it is the pituitary gland which determines the size and shape of the fossa in which it lies.

THE SURGERY OF BRAIN TUMORS: BASED UPON A STUDY OF THE END-RESULTS OF 828 VERIFIED AND PRESUMED TUMORS

The Nathan Lewis Hatfield Lecture

Lecture VI[1]

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There comes a time to one interested in a special field of surgery when it seems desirable to pause and overlook the field he has traversed; not only to discover whether his steps have been wisely directed in the past, but to learn, if possible, how best to direct them in the future. Neurologic surgery, stimulated in this country especially by Keen, Cushing, Frazier and others, has made tremendous strides in the past twenty-five years. The diagnosis and operative treatment of brain tumors have been greatly advanced, the surgery of the Gasserian ganglion very largely perfected, the entire surgery of the hypophysis developed and the diagnosis and treatment of spinal-cord lesions enlarged. The surgery of the peripheral nervous system, of the sympathetic nervous system, of hydrocephalus and epilepsy have been included in the general progress. Indeed, advances have been so rapid that, in our interest in every new development, it has been difficult to pause sufficiently long to discover what we are actually accomplishing. As a result of pessimistic reports from this country and abroad, and of other reports sufficiently vague to leave the reader unsatisfied, there has crept into the minds of most medical

[1] Read December 3, 1924.

men the feeling that neurosurgery, and especially the surgery of brain tumors, leaves very much to be desired. Interested as I have been in the subject, I, too, have had but a vague idea of our accomplishments. To discover more nearly our successes and failures, to discover if possible along what paths we may hope to progress, has been the purpose of this study; and I intend, with your permission, to place before you, as precisely as I am able, just what has been accomplished in one clinic, the Johns Hopkins Hospital, and to suggest what appears to me to be the directions along which our future efforts should be directed.

The study was undertaken at the suggestion of Dr. Halsted, and was begun while I was still in Baltimore. It includes 828 cases of verified and presumed brain tumors which have been admitted to the Johns Hopkins Hospital between the years 1889 and 1920—a period of approximately thirty years. With the exception of 34 cases operated upon by other members of the surgical staff the entire number has been under the care of three men, Cushing, Dandy and Heuer. During the period of their activity neurosurgery has had its greatest growth and development, in which the Johns Hopkins Hospital has taken an active and important part. It is not my purpose to dwell upon its contributions, but rather to point out that in the development of any field of surgery new procedures for the approach to hitherto inaccessible lesions and new attitudes of mind toward the treatment of lesions exposed by operation are usually costly from the standpoints of immediate mortality and results. Thus the results which I shall bring before you, good or bad as they may be, do not represent what can be achieved today either from the standpoint of mortality or late results, but rather what *has been* accomplished over a period of thirty years in a growing field of surgery.

When the series of cases had been tabulated it was found that of the 828 cases, 485, or approximately 60 per cent, were verified brain tumors in the sense that the nature and location of the lesions had been established by operation or autopsy; that 343, or 40 per cent, were not verified either at operation or autopsy and had to be classified, therefore, as presumed brain tumors. In

explanation of these findings it may be said that the diagnosis of brain tumor is made upon the presence of general pressure symptoms, chief among which are headache, vomiting and choked disk; upon focal symptoms indicative of the implication of parts of the brain the function of which is known; and upon other accessory findings furnished by the *x*-ray, either with or without the injection of air into the ventricles, by the Wassermann reaction, by ventricular puncture and so forth. Experience will, I think, bear out the assertion that in the presence of general pressure symptoms, especially choked disk, *brain tumor* is the most probable diagnosis; although it is well known that conditions other than brain tumor may produce them. Cases, therefore, which have presented the clinical symptoms and signs of brain tumor have been so diagnosed unless these symptoms could be definitely attributed to other conditions. That a tumor was not found in 270 cases subjected to operation is not necessarily a reflection upon our diagnostic ability nor proof that a tumor was not present, but rather an indication that the lesion was below the brain surface or in a region at present inaccessible. We know from accumulated experience the usual course and termination of brain tumor sufferers, and it seems certain that a large, although indefinite number of these cases actually harbored a tumor. It is equally certain, however, that a smaller (though again an indefinite number) of these cases did not have brain tumors, for their subsequent history does not permit of this assumption. Although of no great value in many respects for our present purposes, this group of presumed tumors has been included in our study because of the light it throws upon the differential diagnosis of brain tumors and the value of certain operative procedures in the treatment of intracranial conditions associated with general increased intracranial tension.

For convenience we have grouped the cases under cerebral, hypophyseal and suprasellar, cerebellar, cerebellopontine-angle and brain-stem tumors. The story of these various groups of cases is told in Charts I to XII.

Chart 1—VERIFIED CEREBRAL TUMORS.

Total number of cases, 250. Operated upon, 243. Not operated upon, 7.

Type of Lesion. Glioma, 112. Cystic glioma, 32. Cysts, 26. Endothelioma, 45. Syphiloma, 8. Tuberculoma, 7. Osteoma, 3. Angioma, 3. Carcinoma (metastatic), 6. Sarcoma (metastatic), 4. Intracranial aneurysm, 2. Cholesteatoma, 1. Dermoid cyst, 1.

Location of Lesions. Cerebral hemispheres.

Operations. Single or multiple at first admission, 197. Died in hospital, 72. Subsequent operations at subsequent admissions, 46. Died in hospital, 14. Total number of operations, 399. Total number of hospital deaths, 86. Operative mortality, 21 per cent. Case mortality, 35 per cent.

Kind of Operations. Simple decompressions, 13. Deaths, 9. Mortality, 70 per cent.

Craniotomy (osteoplastic flap), without exposure of tumor, 47. Deaths, 37. Mortality, 78 per cent.

Craniotomy (osteoplastic flap), with exposure of tumor but without attempt to remove, 31. Deaths, 11. Mortality, 35 per cent.

Craniotomy (osteoplastic flap), with exposure and removal (complete or partial), 152. Deaths, 29. Mortality, 19 per cent.

Postoperative Complications. Superficial wound infection, 5. Fungus cerebri, 10. Meningitis, 5. Brain abscess, 5. Cerebrospinal fistula, 5. Intracranial hemorrhage, 3. Pneumonia, 10. Hemiplegia—monoplegia, 17. Aphasia (temporary), 15. Hyperpyrexia, 5. Cerebral edema, 7. Respiratory paralysis, 2. Cranial nerve palsies, 1. Cerebral softening, 1. Retained foreign body (cotton), 3.

Immediate Results, 250 Cases. 243 operated upon, with 72 hospital deaths. 171 patients discharged. 7 not operated upon, with 6 hospital deaths. 1 patient discharged, not since heard from.

Late Results, Operative Group. 171 patients discharged. Of these:

(*A*). 57 are Living January 1, 1922.

6 *are living ten years or more.*

3 entirely well.

3 in good health, but with disabilities—spastic paresis of leg; "cramps" of left arm; limp left leg.

Lesions. Endothelioma, 3. Syphiloma, 2. Cyst, 1.

Operation. Removal, 5. No removal, 1. Endothelioma. Well eleven years.

17 *are living five to ten years.*

6 well—1 blind in one eye; 1 limp in one leg.

7 in good health, but with disabilities—epileptic attacks, 5; weakness of arm or leg, 2; impaired vision, 1; headaches, 1.

3 in fair health. Disabilities—epileptic attacks, 1; paresis of arm or leg, 2; blind, 1.

1 in poor health. No improvement; in institution.

Lesions. Endothelioma, 7. Cysts, 6. Glioma, 1. Cystic glioma, 1. Syphiloma, 1. Aneurysm, 1.

Operation. Removal, 16. No removal, 1 (aneurysm).

11 *are living three to five years.*

2 entirely well. 1 vision impaired.

6 in good health. Disabilities—headache, 1; impaired function of arm or leg, 4; blind or impaired vision, 2; convulsions, 2.

2 in fair health. Disabilities—impaired function of arm or leg, 2; convulsions, 1.

1 in poor health. Disabilities—hemiplegia; impaired vision.

Lesions. Endothelioma, 2. Glioma, 2. Cystic glioma, 5. Cysts, 1. Osteoma, 1.

Operation. Removal, 10. No removal, 1 (glioma—in good health four and a half years).

10 *are living one to three years.*

4 entirely well.

3 in good health. Disabilities—convulsions, 2; impaired function of arm and leg, 1.

1 in fair health. Disabilities—convulsions, impaired function of hand.

2 in poor health. Disabilities—headaches, vomiting; convulsions, 1; bedridden, helpless, 1.

Lesions. Endothelioma, 4. Glioma, 2. Cystic glioma, 3. Cyst, 1.

Operation. Removal, 10.

13 *are living less than one year.*

9 entirely well.

2 in good health. Disabilities—convulsions, 1; fainting attacks, 1.

2 in poor health. Not improved by operation.

Lesions. Endothelioma, 4. Glioma, 6. Cyst, 1. Tuberculoma, 1. Angioma, 1.

Operation. Removal, 11. No removal, 2 (glioma, angioma).

(*B*). 85 Lived for a Time but Subsequently Died.

1 *lived ten years or more.*

Good health; occasional convulsion.

Lesion. Endothelioma.

Operation. No removal.

8 *lived five to ten years.*

1 entirely well.

3 fair health. Disabilities—epileptic attacks, 3; impaired mentality, 1.

4 in poor health. Disabilities—epileptic attacks, 2; palsies of arm or leg, 2; blind, 1; impaired mentality, 1.

Lesions. Endothelioma, 3. Glioma, 1. Cyst, 3. Syphiloma, 1.

Operation. Removal, 7. No removal, 1 (syphiloma).

5 *lived from three to five years.*

1 in good health with epileptic attacks.

2 in fair health—no record of disabilities.

2 in poor health. Disabilities—mentally unbalanced, 1; hemiplegia, 1.

Lesions. Glioma, 1. Cystic glioma, 4.

Operation. Removal, 4. No removal, 1 (cystic glioma removed later).

17 *lived from one to three years.*

1 entirely well.

3 in good health. Disabilities—blind, 1; somewhat aphasic, 1; "moral depravity," 1.

6 in fair health. Disabilities—impaired function of arm and leg, 2; epileptic attacks, 1; no disabilities noted, 3.

6 in poor health. Disabilities—no improvement in symptoms, 2; impaired mentality, 2; progressive paralysis, 2.

1 condition not reported.

Lesions. Endothelioma, 1. Glioma, 10. Cystic glioma, 2. Cyst, 1. Syphiloma, 1. Carcinoma (metastatic) 1. Aneurysm, 1.

Operation. Removal, 9. No removal 8 (glioma 7; aneurysm, 1).

54 *lived less than one year.*

2 well until shortly before death.

15 whose health improved over condition before operation.

37 whose health was unimproved over condition before operation. (In some cases relief of pressure symptoms.)

Lesions. Endothelioma, 2. Glioma, 35. Cystic glioma, 6. Cysts, 3. Sarcoma (metastatic), 4. Carcinoma (metastatic), 2. Dermoid cyst, 1. Tubercle, 1.

Operation. Removal, 32. No removal, 22 (glioma, 19; endothelioma, 1; sarcoma, 1; carcinoma, 1.)

(*C*). 29 Lived for a Time but have been Lost Sight of.
(*No data after period indicated.*)

1 *lived three years.*
Poor health. Mind affected. In institution.
Lesion. Cystic glioma.
Operation. Removal.

2 *lived two years.*
1 in poor health. No improvement. Prompt recurrence.
Lesion. Cystic glioma.
Operation. Removal.

1 in fair health. Convulsive seizures frequent.
Lesion. Syphiloma.
Operation. Removal.

1 *lived one year.*
Condition not noted.
Lesion. Glioma.
Operation. Removal.

25 *lived less than one year.*
1 well.
5 whose health improved over condition before operation.
2 whose health was unimproved over condition before operation.
17 give no data of condition. Lost sight of after leaving hospital.
Lesions. Endothelioma, 1. Glioma, 11. Cystic glioma, 2. Cysts, 5. Tuberculoma, 1. Syphiloma, 1. Angioma, 2. Osteoma, 2.
Operation. Removal, 19. No removal, 6 (glioma, 4; angioma, 2).

Chart II—VERIFIED HYPOPHYSEAL AND SUPRASELLAR TUMORS.

Total number of cases, 74. Operated upon, 72. Not operated upon, 2.

Type of Lesion. Adenoma, 40. Cysts, 12. "Struma," 9. Glioma, 4. Sarcoma, 4. Endothelioma, 2. Teratoma, 2. Solitary Tubercle, 2.

Location of Lesions. Hypophysis, 62. Suprasella, 6. Interpeduncular, 4. Optic Nerves and Chiasm, 2.

Operations. (*a*) Single or multiple at first admission, 56. Died in hospital, 29. (*b*) Subsequent operations at subsequent admissions, 16. Died in hospital, 7. (*c*) Total number of operations, 109. Total number of hospital deaths, 36. Operative mortality, 33 per cent. Case mortality, 50 per cent.

Kind of Operations. Transphenoidal, 21; deaths, 6. Intracranial, 35; deaths, 21. Simple decompression, 6; deaths, 3. Decompression followed by transphenoidal, 5; deaths, 2. Decompression followed by intracranial, 4; deaths, 3. Ventricular puncture (air injection), 1; deaths, 1.

Fatal Postoperative Complications. Meningitis, 4. Pneumonia, 4. Cerebral compression, 3. Pulmonary embolism and infarction, 1. Extradural hemorrhage, 1. Sinus thrombosis pulmonary embolism, 1. Cerebral anemia, 1.

Immediate Results. 72 patients operated upon with 29 hospital deaths. 43 patients discharged. 2 cases not operated upon and discharged.

LATE RESULTS, OPERATIVE GROUP. 43 patients discharged. Of these:

11 ARE LIVING JANUARY 1, 1922.

2 *are living ten years.*

1 entirely well.

1 in good health, but with headaches and imperfect vision.

Lesions. Adenoma, 2.

Operation. Transphenoidal, 2 (partial removal).

3 *are living five to ten years.*

Good health. Disabilities—blind, 1; impaired vision, 1; forgetfulness and somnolence, 1.

Lesions. Adenoma, 2. Glioma, 1.

Operation. Intracranial, 2 (removal, 1; no removal, 1). Transphenoidal, 1 (partial removal).

2 *are living three to five years.*

Good health. Disabilities—Vision impaired, 1; petit mal attacks (uncinate gyrus), 1.

Lesions. Adenoma, 2.

Operation. Intracranial, 2 (removal).

1 *is living one to three years.*

Entirely well. No complaints or disabilities.

Lesion. Adenoma.

Operation. Intracranial (removal).

3 *are living less than one year.*

2 entirely well.

1 in poor health. Headaches, failing vision, confined to bed.

Lesions. Cyst, 2. Cystic adenoma, 1.

Operation. Intracranial, 3 (removal).

23 Lived for Some Time but Eventually Died.

1 *lived over ten years.*

Poor health. Headaches, convulsions, aphasia.

Lesion. Adenoma.

Operation. Subtemporal decompression (no removal).

4 *lived five to ten years.*

1 in good health; vision improved; very fat.

3 in poor health. Disabilities—1 never recovered vision, headaches; 1 bedridden for six years; 1 blind, headaches, convulsions.

Lesions. Adenoma, 3. Teratoma, 1.

Operation. Transphenoidal, 2 (partial removal). Intracranial, 1 (no removal). Subtemporal decompression, 1 (no removal).

2 *lived three to five years.*

1 entirely well for three years, then return of symptoms.

1 in good health, but never free from symptoms.

Lesions. Gliosarcoma chiasm, 1. Adenoma, 1.

Operation. Intracranial, 1 (removal). Transphenoidal, 1 (partial removal).

9 *lived one to three years.*

1 entirely well for one year, then return of symptoms.

1 in good health, but with headaches and impaired vision.

5 improved in health, but with headaches, etc.

2 in poor health; unimproved.

Lesions. Adenoma, 4. Cysts, 3. Solitary tubercle, 1. Angiosarcoma, 1.

Operation. Transphenoidal, 5 (partial removal). Intracranial, 3 (removal). Subtemporal decompression, 1 (no removal).

7 *lived less than one year.*

1 entirely well for six months, then return of symptoms.

2 improved in health; relief of headaches, etc.

4 in poor health; unimproved.

Lesions. Adenoma, 3. Cysts, 3. Sarcoma, 1.

Operation. Transphenoidal, 5 (partial removal, 4; no removal, 1). Intracranial, 2 (removal).

9 Lived for Some Time but End-result Not Known.

1 *lived five to ten years.*

In good health for seven years. Readmitted for second operation. Not heard from.

Lesion. Adenoma.
Operation. Subtemporal decompression (no removal).

2 *lived three to five years.*
1 in good health. No complaints.
1 in poor health Unable to work; headaches.
Lesions. Adenoma, 2.
Operation. Transphenoidal (partial removal, 1; no removal, 1).

3 *lived one to three years.*
1 in good health, but with headaches.
1 improved in health, but not free from symptoms.
1 in poor health; no improvement.
Lesions. Adenoma, 3.
Operation. Transphenoidal, 2 (partial removal, 1; no removal, 1). Intracranial, 1 (removal).

3 *lived less than one year.*
1 entirely well for seven months.
1 improved in health, but not free from symptoms.
1 in poor health; unimproved.
Lesions. Adenoma, 3.
Operation. Transphenoidal, 3 (partial removal).

Late Results, Non-operative Group. 2 patients.

1 subsequently operated upon at another hospital. Health improved in one and a half years. Died.
1 lived eight months after discharge. Died.

Chart III—VERIFIED CEREBELLAR TUMORS.

Total number of cases, 86. Operated upon, 85. Not operated upon, 1. (*Died in hospital—tubercle.*)

Type of Lesion. Glioma, 28. Ependymal glioma (arising choroid plexus, fourth ventricle), 6. Cystic glioma, 21. Cysts, 19. Endothelioma (arising from tentorium), 2. Sarcoma (glioma?), 4. Tuberculoma, 2. Carcinoma, 1. Osteoma, 1. Angioma, 1.

Location of Lesion. Intracerebellar, 77 (left lobe, 30; right lobe, 14; vermis, 8; general (both lobes and vermis), 25). Extracerebellar, 8 (secondarily implicating cerebellum—fourth ventricle, 6; tentorium, 2).

Operations. Single or multiple at first admission, 65; died in hospital, 26. Subsequent operations at subsequent admissions, 20; died in hospital, 15. Total number of operations, 138. Total number of deaths, 41. Operative mortality, 29 per cent. Case mortality, 48 per cent.

Kind of Operations. Suboccipital exploration and decompression, 80. Atypical Operations: Subtemporal decompression in comatose patients, 2; subtemporal decompression, mistaken diagnosis, 1; transphenoidal (hypophysis), mistaken diagnosis, 1; callosal puncture for hydrocephalus, 1.

Postoperative Complications. Meningitis (fatal), 3. Pneumonia (fatal), 2. Respiratory paralysis (fatal), 3. Cerebrospinal fistula, 1. Scarlet fever, 1. Wound infection, 1. Spasticity, extremities (fatal), 1.

Immediate Results. 86 cases. 85 operated upon with 26 deaths. 59 patients discharged. 1 not operated upon; died in hospital. Solitary tubercle.

Late Results, Operative Group. 59 patients discharged. Of these:

28 are Living January 1, 1922.

6 *are living ten or more years.*

2 entirely well.

4 in good health. Disabilities—staggering gait, 3; impaired function of arm, 2.

Lesions. Glioma (enucleable), 1. Cystic glioma, 2. Cysts, 3.

Operation. Removal or evacuation, 6.

8 *are living five to ten years.*

3 entirely well.

4 in good health. Disabilities—staggering gait, 3; poor vision, 1.

1 in poor health. Disabilities—headaches, vomiting, staggering.

Lesions. Glioma, 1. Ependymal glioma, 1. Cystic glioma, 2. Cysts, 4.

Operation. Removal or evacuation, 8.

5 *are living three to five years.*

1 entirely well.

4 in good health. Disabilities—staggering gait, 3; blind, 1; poor vision, 2.

Lesions. Cystic glioma, 2. Cysts, 3.

Operation. Removal or evacuation, 5.

5 *are living one to three years.*

1 entirely well.

3 in good health. Disabilities—staggering gait, 1; poor vision, 2.

1 in poor health. Disabilities—staggering gait, poor vision.

Lesions. Glioma, 1. Cystic glioma, 2. Cysts, 2.

Operation. Removal or evacuation, 5.

4 *are living less than one year.*

2 entirely well.

2 good health. Disabilities—staggering, unable to walk, 1; poor vision, 1.

Lesions. Glioma, 2. Cystic glioma, 1. Cyst, 1.
Operation. Removal or evacuation, 4.

25 Lived for a Time but Subsequently Died.

0 *lived ten years or more.*
8 *lived three to ten years* (2 *from five to ten years*).
2 entirely well.
2 in good health. Disabilities—staggering gait, unable to walk, 1; blind, headaches, 1.
4 improved in health. Never free from symptoms; recurrence of disease.
Lesions. Glioma, 1. Cystic glioma, 5. Cysts, 2.
Operation. Removal or evacuation, 8.

6 *lived one to three years.*
1 entirely well.
5 improved in health. Never free from symptoms; recurrence of disease.
Lesions. Glioma, 4. Cyst, 1. Endothelioma, 1.
Operation. Removal or evacuation, 5. No removal (decompression), 1.

11 *lived less than one year.*
None entirely well. Never free from symptoms; recurrence of disease.
6 improved in health. Never free from symptoms; recurrence of disease.
5 not improved in health. No relief of symptoms; progressive down-hill course.
Lesions. Glioma, 6. Sarcoma (glioma?), 3. Carcinoma (metastatic), 1. Angioma, 1.
Operation. Removal, 7. No removal (decompression), 4.

6 Lived for a Time, but were Lost Sight of.

(*No data after time indicated.*)

None lived over ten years.
None lived five to ten years.
2 *lived three to five years.*
None entirely well.
1 in good health. Disabilities—staggering gait, double vision, 1.
1 in poor health. Disabilities—blind, paralyzed.
Lesions. Cysts, 2.
Operation. Evacuation, 2.

1 *lived one to three years.*

1 in poor health. In state hospital; incapacitated.

Lesion. Cyst.

Operation. Evacuation.

3 *lived less than one year.*

Results not known. No data regarding health.

Lesions. Glioma, 1. Cyst, 1. Osteoma, 1.

Operation. Removal, 2. No removal (decompression), 1.

Chart IV—VERIFIED CEREBELLOPONTINE-ANGLE TUMORS.

Total number of cases, 40. Operated upon, 40.

Type of Lesion. Endothelioma, 25. Acoustic neuroma, 3. Neurofibroma, 2. Fibrosarcoma, 5. Glioma, 5. (Probable that first four groups represent the same general type of tumor.)

Location of Lesion. Left angle, 25. Right angle, 12. Bilateral, 1. Not stated, 2.

Operations. Single or multiple at first admission, 35; died in hospital, 23. Subsequent operations at subsequent admissions, 5; died in hospital, 4. Total number of operations, 53. Total deaths, 27. Operative mortality, 50 per cent. Case mortality, 67.5 per cent.

Kind of Operation. Suboccipital approach with total enucleation of tumor, 18; deaths, 14; mortality, 77 per cent. Suboccipital approach with partial removal (intracapsular), 8; deaths, 3; mortality, 37.5 per cent. Suboccipital approach with evacuation cysts overlying tumors (no removal tumors), 2; deaths, 0. Suboccipital approach with no removal tumor (decompression), 12; deaths, 10; mortality, 83 per cent.

Postoperative Complications. All fatal. Bronchopneumonia, 4. Meningitis, 2 (1 wound infection; 1 acute mastoid). Radium reaction (radium inserted into capsule), 1.

Immediate Results. 40 cases. 40 operated upon, with 23 deaths. 17 discharged.

Late Results. 17 patients discharged. Of these:

(*A*) 8 are Living January 1, 1922.

3 *are living ten years or more.*

None entirely well.

3 in good health. Disabilities—staggering gait, 3; impaired vision and hearing, 1.

Lesions. Endothelioma, 3.

Operation. Partial removal, 2. Evacuation cyst (no removal of tumor) 1.

1 *is living five to ten years.*

1 in good health. Disabilities—impaired vision and hearing.

Lesion. Endothelioma.

Operation. Total removal.

1 *is living three to five years.*

Poor health. Disabilities—staggering gait, headaches and vomiting.

Lesion. Endothelioma.

Operation. Evacuation cyst. No removal of tumor.

1 *is living one to three years.*

Good health. Disabilities—staggering gait, blind.

Lesion. Endothelioma.

Operation. Partial removal.

2 *living less than one year.*

1 entirely well.

1 in good health. Disabilities—staggering gait, cannot walk.

Lesions. Endothelioma, 1. Glioma, 1.

Operation. Complete removal.

(*B*) 7 Lived for a Time but Subsequently Died.

None lived ten years or more.

2 *lived three to ten years.*

1 entirely well.

1 in good health one and a half years. Disabilities—bedridden for three years.

Lesions. Endothelioma, 1. Acoustic neuroma, 1.

Operation. Partial removal, 2.

2 *lived one to three years.*

None entirely well.

2 improved in health. Never free from symptoms; continuation or recurrence of disease.

Lesion. Endothelioma, 1. Fibrosarcoma, 1.

Operation. No removal (decompression). 1 case reoperated on just before death.

3 *lived less than one year.*

None entirely well.

3 improved in health. Never free from symptoms; reoperation; death.

Lesions. Endothelioma, 2. Glioma, 1.

Operation. Partial removal, 2. No removal (decompression), 1.

(*C*) 2 Lived for a Time but were Lost Sight of.
(*No data after time indicated.*)

Results not known. No data regarding health.
Lesions. Endothelioma. Glioma.
Operation. No removal, 2.

Chart V—VERIFIED BRAIN-STEM TUMORS.

Total number of cases, 35. Operated upon, 33. Not operated upon, 2 (*died in hospital*).

Type of Lesion. Glioma, 25. Ependymal glioma, 2. Solitary tubercle, 2. Endothelioma, 1. Teratoma, 1. Cholesteatoma, 1. Cyst, 1. Carcinoma (metastatic), 1. Aneurysm basilar artery, 1.

Location of Lesions. Pons, 12. Brain stem largely involved, 6. Corpora quadrigemina, 2. Pons and basal ganglia, 2. Brain stem and fourth ventricle, 6. Brain stem and third ventricle, 3. Pineal gland, 3. Base of skull involving pons, 1.

Operations. Single or multiple at first admission, 31; died in hospital, 26. Subsequent operations at subsequent admissions, 2; died in hospital, 2. Total number of operations, 44. Total deaths, 28. Operative mortality, 75 per cent. Case mortality, 84 per cent.

Kind of Operations. Suboccipital exploration and decompression, 21. Suboccipital and cerebral exploration and decompression, 2. Cerebral exploration and decompression, 5. Subtemporal decompression, 3. Transphenoidal (hypophyseal), 1. Ventricular puncture, 1.

Removal of Tumors. No removal, 25. Partial removal, 5 (teratoma, base of skull, 1; cholesteatoma, fourth ventricle, 1; glioma, fourth ventricle, 2; glioma, infundibular region, 1). Apparently total removal, 3 (cyst medulla, 1; pineal gland tumor, 2).

Postoperative Complications. Bronchopneumonia, 3. Cerebral fungus, 1. Hyperpyrexia, 1. Aphasia, 1. Extradural hemorrhage, 1. Shock, 1. Subdural abscess, 1.

Immediate Results. 35 cases. 33 operated upon with 26 deaths. 7 patients discharged. 2 not operated upon with 2 deaths.

Late Results. 7 patients discharged. Of these:

(*A*) None are Living January 1, 1922.

(*B*) 5 Lived for a Time but Subsequently Died.

1 *lived one to three years.*

Health improved, but never free from symptoms.
Lesion. Cyst medulla.
Operation. Evacuation.

4 *lived less than one year.*

Health unimproved.

Lesions. Glioma, 3. Tubercle pineal, 1.

Operation. Removal, 1 (tubercle pineal gland). No removal, 3 (gliomas).

(*C*) 2 Lived for a Time but were Lost Sight of.

Results not known. No data about health.

Lesions. Gliomas, 2.

Operation. No removal, 2.

Chart VI—GENERAL SUMMARY OF VERIFIED BRAIN TUMORS.

Total number of cases, 485.

1. *Verified Cerebral Tumors,* 250. Operated upon, 243. Hospital deaths, 72. Patients discharged, 171. Of these:

49 *lived beyond a three-year period.*

12 entirely well.

18 in good health, but with some disabilities.

10 in fair health, but more serious disabilities.

9 in poor health, but with very serious disabilities (incapacitating).

20 per cent of patients operated upon.

29 per cent of patients discharged.

2. *Verified Hypophyseal and Suprasellar Tumors,* 74. Operated upon, 72. Hospital deaths, 29. Patients discharged, 43. Of these:

17 *lived beyond a three-year period.*

2 entirely well.

9 in good health, but with some disability (chiefly impaired vision).

1 in fair health, but with more serious disabilities.

5 in poor health, but with serious disabilities.

23 per cent of patients operated upon.

40 per cent of patients discharged.

3. *Verified Cerebellar Tumors,* 86. Operated upon, 85. Hospital deaths, 26. Patients discharged, 59. Of these:

29 *lived beyond a three-year period.*

8 entirely well.

15 in good health, but with some disabilities.

4 in fair health, but with more serious disabilities.

2 in poor health, but with very serious disabilities.

34 per cent of patients operated upon. 49 per cent of patients discharged.

4. *Verified Cerebellopontine-Angle Tumors*, 40. Operated upon, 40. Hospital deaths, 23. Patients discharged, 17. Of these:

7 *lived beyond a three-year period.*

1 entirely well.
5 in good health.
1 in poor health.

17.5 per cent of patients operated upon. 41 per cent of patients discharged.

5. *Verified Brain-stem Tumors*, 35. Operated upon, 33. Hospital deaths, 26. Patients discharged, 7. Of these:

None lived beyond a three-year period.

Totals. Of 473 verified brain tumors operated upon, 176 died; 297 discharged. Of these:

102 *lived beyond a three-year period.*

23 entirely well (5 per cent).
47 in good health.
15 in fair health.
17 in poor health.

21.5 per cent of patients operated upon. 34 per cent of patients discharged.

Chart VII—PRESUMED CEREBRAL TUMORS.

Total number of cases, 199. Operated upon, 158. Not operated upon, 41.

Presumed Type of Lesions.

(*a*) Verified by later operation or autopsy, 9 (no tumor (pseudo tumor)), 4; arteriosclerosis, 2 (with softening, 1); chronic basilar meningitis, 1; sinus thrombosis with hemorrhage, 1; toxemia with ventricular hemorrhage, 1).

(*b*) Metastatic (not proven), 7 (carcinoma of breast, 6; hypernephroma, 1).

(*c*) Tuberculoma or syphiloma 11 (not proven; from history and physical examination).

(*d*) Serous meningitis, 15 (not proven; from history, examination and operative findings).

(*e*) Hemorrhagic cysts, 2 (pachymeningitis hemorrhagica? (from operation)).

(*f*) Brain tumors, 155 (represents opinion of observers—speculation).

Presumed Location of Lesions. Frontal lobe, 14. Temporal lobe, 20. Paracentral, 5. Parieto-occipital, 6. Right hemisphere, 55. Left hemisphere, 41. Unlocalizable, 48.

Operations. Single or multiple on first admission, 146. Died in hospital, 15. Subsequent operations at subsequent admissions, 12. Died in hospital, 2. Total number of operations, 196. Total number of deaths, 17. Operative mortality, 8 per cent. Case mortality, 10 per cent.

Kind of Operations. Simple subtemporal decompression, 61. Exploratory craniotomy combined with decompression, 82. Decompression followed later by exploratory craniotomy, 15.

Postoperative Complications. Extradural hemorrhage, 3. Meningitis, 1. Fungus cerebri, 1. Aphasia (temporary), 10. Cerebrospinal fistula, 1. Bronchopneumonia, 1. Wound infection, 1.

Immediate Results. 199 cases. 158 operated upon with 15 deaths. 143 patients discharged. 41 not operated upon, with 3 deaths. 38 patients discharged.

LATE RESULTS, OPERATIVE GROUP. 143 patients discharged. Of these:

(*A*). 50 ARE LIVING JANUARY 1, 1922.

18 *living ten years or more.*

4 entirely well.

12 in good health. Disabilities—paralysis, 2; convulsive seizures, 7; blind, 1; headaches, 2; speech defects, 1.

2 in poor health. Disabilities—headaches, blind, convulsions, 1; "unable to work for nine years," 1.

Operation. Subtemporal decompression, 11. Exploration and decompression, 7.

16 *living five to ten years.*

3 entirely well.

7 in good health. Disabilities—headaches, 4; failing vision, 2; convulsions, 2; mental depression, 1.

3 in fair health. Disabilities—headaches, 2; petit mal, 2; underweight but no symptoms.

3 in poor health. Disabilities—paralysis, helpless, 2; blind or poor vision, 2; headaches, 2.

Operation. Subtemporal decompression, 8. Exploration and decompression, 8.

7 *are living three to five years.*

3 entirely well.

2 in good health. Disabilities—headaches, vomiting, failing vision, 1; headaches, staggering gait, 1.

2 in poor health. Disabilities—impaired mentality, 1; headaches, vomiting, declining vision, 1.

Operation. Subtemporal decompression, 2. Exploration and decompression, 5.

6 *living one to three years.*

1 entirely well.

2 in good health. Disabilities—headaches, 1; blindness in one eye, 1.

3 in poor health. Disabilities—blind, headaches, staggering gait, 1; bedridden, paralysis, 2.

Operation. Subtemporal decompression, 3. Exploration and decompression, 3.

3 *living less than one year.*

2 entirely well.

1 in good health. Minor complaints.

Operation. Subtemporal decompression, 1. Exploration and decompression, 2.

(*B*). 50 Lived for a Time but Subsequently Died.

3 *lived ten years or more.*

None entirely well.

3 in good health. Disabilities—epileptic attacks, 1 (died of pellagra); headaches, 1 (died from accident); Bright's disease, 1 (died).

Operation. Exploration and decompression, 3.

7 *lived five to ten years.* None entirely well.

3 in good health. Disabilities—progressive inability to walk, 1; progressive loss of vision, 1; convulsive seizures, 1.

4 in poor health. Disabilities—blind, impaired mentality, 1; poor vision, invalid in infirmary, 1; bedridden one year, 1; epileptic attacks, 1.

Operation. Decompression, 5. Exploration and decompression, 2.

3 *lived three to five years.* None entirely well.

2 in good health. Disabilities—headaches, impaired vision, 1; blind, impaired mentality, 1.

1 in poor health. Disabilities—blind, helpless for two years.

Operation. Decompression 1. Exploration and decompression, 2.

10 *lived one to three years.*

1 entirely well. Sudden death.

6 in good health. Disabilities—convulsive seizures, 2; headaches, 2; failing vision, 1.

3 in poor health. Disabilities—no improvement in symptoms; died of disease.

Operation. Decompression, 2. Exploration and decompression, 8.

27 *lived less than one year.* None entirely well.
11 improved in health. Disabilities—never free from symptoms; headaches, failing vision, convulsive seizures.
16 unimproved in health. Disabilities—symptoms unabated or increasing in severity.
Operation. Decompression, 10. Exploration and decompression, 17.

(*C*). 43 Lived for a Time, but Lost Sight of.
(*No data after time indicated.*)

None lived ten years or more.
2 *lived five to ten years.* None entirely well.
2 in good health. Disabilities—epileptic attacks, 2.
Operation. Decompression, 1. Exploration and decompression, 1.

4 *lived three to five years.*
1 entirely well.
2 in good health. Disabilities—convulsions, 2.
1 in poor health. No improvement in symptoms.
Operation. Decompression, 2. Exploration and decompression, 2.

4 *lived one to three years.*
2 entirely well.
1 in good health. No disabilities.
1 in poor health. No improvement in symptoms.
Operation. Decompression, 3. Exploration and decompression, 1.

33 *lived less than one year.*
2 entirely well.
21 improved in health, but never free from symptoms.
10 unimproved in health. Symptoms unabated or worse.
Operation. Decompression, 16. Exploration and decompression, 17.

Late Results, Non-operative Group (*Operation not advised or refused*).
38 patients discharged. Of these:

12 are Living January 1, 1922.

4 *living ten years or more.*
2 entirely well.
2 in good health. Disabilities—headaches, 1; headaches, vomiting, poor vision, 1.
2 *living five to ten years.* None entirely well.
2 in good health. Disabilities—headaches, poor vision, 2.
3 *living three to five years.*
1 entirely well.
2 in good health. Disabilities—headaches, 1; epileptic attacks, 1.

3 *living one to three years.*
2 entirely well.
1 in good health. Disabilities—difficulty in walking.

8 Lived for a Time but Subsequently Died.

None lived ten years or more.
3 *lived five to ten years.* Results not exactly known.
1 died five years after discharge. No notes concerning health.
1 never improved and died five years after discharged.
1 died nine years after discharge in T. B. Sanitarium. No other data.
None lived three to five years.
2 *lived one to three years.* Results not exactly known.
1 died; no notes concerning health.
1 died of "cancer;" no other notes.
3 *lived less than one year.*
Results not known. No data.

18 Lived for a Time but were Lost Sight of.

Nothing known about this group. No data could be obtained.

Chart VIII—PRESUMED HYPOPHYSEAL TUMORS.

Total number of cases, 40. Operated upon, 19. Not operated upon, 21.

Presumed Type of Lesion. Speculative.

Presumed Location of Lesion. Hypophyseal or suprasellar.

Operations. Single or multiple at first admission, 15; died in hospital, 0. Subsequent operations at subsequent admissions, 4; died in hospital, 0. Total number of operations, 26. Total number of deaths, operative and case mortality, 0 per cent.

Kind of Operation. Transphenoidal sellar decompression, 9 (with removal of tissue, 4; without removal of tissue, 5). Subtemporal decompression, 2. Craniotomy and decompression, 4. Sellar decompression and subtemporal decompression, 2. Cerebellar exploration and decompression, 1. Ventricular puncture, 1.

Postoperative Complications. Cerebrospinal rhinorrhea, 2. Palsy cranial nerve III, 1. Meningitis (recovery), 1.

Immediate Results. 19 cases operated upon with no deaths; 19 patients. discharged. 21 cases not operated upon with no deaths; 21 patients discharged.

LATE RESULTS, OPERATIVE GROUP. 19 patients discharged. Of these:

8 ARE LIVING JANUARY 1, 1922.

3 *are living ten years or more.*

1 entirely well.

2 fair in health. Disabilities—headaches, pain in eyes, 1; blind, headaches, vomiting, 1.

Operation. Sellar decompression and removal of tissue, 2. Sellar and subtemporal decompression. No removal of tissue, 1.

4 *living five to ten years.*

1 entirely well.

3 in good health. Disabilities—impotence, 1; headaches, nervousness, 1; impaired vision, 1.

Operation. Sellar decompression and removal of tissue, 1. Sellar decompression, no removal of tissue, 1. Sellar and subtemporal decompression, no removal of tissue, 1. Intracranial, no removal of tissue, 1.

1 *living three to five years.*

1 in good health. Disabilities—occasional headache.

Operation. Sellar decompression; no removal of tissue, 1.

7 LIVED FOR A TIME BUT SUBSEQUENTLY DIED.

None lived ten years or more.

2 *lived five to ten years.*

1 in fair health. Disabilities—totally blind, paresis.

1 result not known. No data regarding health.

Operation. Sellar decompression. No removal of tissue, 2.

1 *lived three to five years.*

1 in fair health. Disabilities—epileptic attacks.

Operation. Intracranial; no removal of tissue.

2 *lived one to three years.*

1 in good health. No complaints.

1 improved in health. Disabilities—persistent headaches.

Operation. Cerebellar exploration and decompression, 1. Craniotomy, 1.

2 *lived less than one year.*

1 improved in health. Disabilities—symptoms continued; committed suicide.

1 result not known.

Operation. Sellar decompression and removal of tissue, 1. Subtemporal decompression, 1.

4 Lived for a Time but were Lost Sight of.

None lived ten years or more.

1 *lived five to ten years.*

1 in fair health. Disabilities—headaches, vomiting.

Operation. Exploratory craniotomy and decompression.

1 *lived three to five years.*

1 in fair health. Disabilities—impaired vision, attacks of stupor.

Operation. Subtemporal decompression.

1 *lived one to three years.*

1 improved in health. Disabilities—mental deficiency, enormous appetite.

Operation. Sellar decompression, no removal of tissue.

1 *lived less than one year.*

1 result not known; no data.

Operation. Ventricular puncture.

Late Results, Non-operative Group. 21 cases discharged. Of these:

7 are Living January 1, 1922.

4 *living ten years or more.*

3 in good health. Disabilities—headaches, 2; impaired vision, 2; vertigo, over-weight, 1; stomach trouble, 1.

1 in fair health. Disabilities—severe headaches, attacks of unconsciousness.

3 *are living five to ten years.*

1 in good health. Disabilities—arthritis of knees and hip.

2 in fair health. Disabilities—impaired use of hands, failing memory, nervous, 2.

5 Lived for a Time but Subsequently Died.

None lived ten years or more. None lived five to ten years. None lived three to five years.

3 *lived one to three years.*

1 in good health. Disabilities—plunging goiter. Removed during stay in hospital.

2 in fair health. Disabilities—1 has failing vision. Died after operation at another hospital. 1 blind. This case later verified. Tumor shadow *x*-ray.

1 *lived less than one year.*

1 result not known. Died during influenza epidemic.

9 Lived for a Time but were Lost Sight of.

1 *lived ten years or more.*
1 in good health. Disabilities—arthritis of knees.

2 *lived five to ten years.*
1 entirely well.
1 in poor health. Disabilities—failing vision, headaches. Later operated upon by H. C. at P. B. B. Still later, decompression for headaches.

2 *lived one to three years.*
2 improved in health. Glandular therapy.

4 *lived less than one year.*
1 improved in health. Glandular therapy.
3 result not known. No data.

Chart IX—PRESUMED CEREBELLAR TUMORS.

Total number of Cases, 84. Operated upon, 77. Not operated upon, 7.

Presumed Type of Lesion.

(*a*) Verified by later operation or autopsy, 5 (internal hydrocephalus (no tumor), 4; cerebellar hemorrhage—extension into ventricles, 1 (nephritis, toxemia?).

(*b*) Presumed chronic serous meningitis, 11.

(*c*) Presumed chronic infections (lues), 2.

(*d*) Presumed metastatic (sarcoma), 1.

(*e*) Presumed brain tumor?, 65.

Presumed Location of Lesion. Cerebellum or posterior fossa.

Operations. Single or multiple at first admission, 69; died in hospital, 10. Subsequent at subsequent admissions, 8; died in hospital, 0. Total number of operations, 96. Total number of deaths, 10. Operative mortality, 10 per cent. Case mortality, 13 per cent.

Kind of Operations. Suboccipital exploration and decompression, 63. Subtemporal decompression, 7. Subtemporal and suboccipital decompression, 4. Callosal puncture, 2. Ventricular puncture, 1.

Postoperative Complications. Cerebrospinal fistula, 3. Hyperpyrexia, 1. Cyanosis (death), 1. Bulbar symptoms, 1. Thrombosis femoral vein, 1. Bronchopneumonia, 1. Toxemia pregnancy (death), 1.

Immediate Results. 84 cases. 77 operated upon with 10 deaths—67 patients discharged. 7 not operated upon with 1 death—6 patients discharged.

LATE RESULTS, OPERATIVE GROUP. 67 patients discharged. Of these:

(*A*). 22 ARE LIVING JANUARY 1, 1922.

7 *living ten years or more.*

1 entirely well.

4 in good health. Disabilities—headaches and convulsions, 2; vertigo and staggering, 1; impaired function of hands, 3.

1 in fair health. No complaints.

1 in poor health. Disabilities—bedridden, paralyzed.

Operation. Suboccipital decompression, 6. Subtemporal and suboccipital decompression, 1.

9 *living five to ten years.*

5 entirely well.

4 in good health. Disabilities—poor vision or blind, 3; staggering gait, 1; deafness in one ear, 1.

Operation. Suboccipital exploration and decompression, 9.

1 *living three to five years.*

1 in good health. Disabilities—poor vision.

Operation. Suboccipital exploration and decompression, 1.

3 *living one to three years.*

1 entirely well.

1 in good health. Disabilities—headache, poor vision.

1 in poor health. Disabilities—bedridden, headaches, poor vision.

Operation. Suboccipital exploration and decompression, 3.

2 *living less than one year.*

2 in good health. No complaints.

Operation. Cerebellar exploration and decompression, 1. Ventricular puncture, 1.

(*B*). 28 LIVED FOR A TIME BUT SUBSEQUENTLY DIED.

None lived ten years or more.

4 *lived five to ten years.*

1 in good health. No complaints.

2 in fair health. Disabilities—headaches, nervousness, 1; blind, unable to walk, 1.

1 in poor health. Disabilities—headaches, unable to work, despondent.

Operation. Suboccipital exploration and decompression, 3. Subtemporal decompression 1.

1 *lived three to five years.*

1 in good health. Disabilities—well for one and a half years, since then ataxia, unable to walk.

Operation. Suboccipital exploration and decompression.

6 *lived one to three years.*

5 in fair health. Disabilities—headaches, ataxia, poor vision; 1 committed suicide.

1 in poor health. Disabilities—headaches: committed suicide.

Operation. Suboccipital exploration and decompression, 5. Subtemporal decompression, 1.

17 *lived less than one year.*

4 improved in health. Never free from symptoms.

13 not improved in health. Symptoms unabated or worse.

Operation. Suboccipital exploration and decompression, 16. Subtemporal decompression, 1.

(*C*). 17 Lived for a Time but were Lost Sight of.

1 *lived ten years or more.*

1 in good health. Disabilities—headache, ataxia.

Operation. Suboccipital exploration and decompression.

1 *lived five to ten years.*

1 in good health. Disabilities—vertigo and tinnitus.

Operation. Suboccipital exploration and decompression.

1 *lived one to three years.*

1 in fair health. Disabilities—weak, below par.

Operation. Suboccipital exploration and decompression.

14 *lived less than one year.*

1 entirely well.

2 improved in health. Never free from symptoms.

3 not improved in health. Symptoms unabated or worse.

8 result not known. No data.

Late Results, Non-operative Group. 7 patients—1 died in hospital, 6 discharged. Of these:

(*A*). 2 are Living January 1, 1922.

1 *living five years.*

1 entirely well, except for slight ataxia.

1 *living for one year.*

1 entirely well.

(*B*). 1 Lived for a Time but Subsequently Died.

1 *lived eight years.*
1 in good health. No complaints.

(*C*). 3 Lived for a Time but were Lost Sight of.

3 *lived less than one year.*
1 in poor health. No improvement in symptoms.
2 result not known. No data.

Chart X—PRESUMED CEREBELLOPONTINE-ANGLE TUMORS

Total number of cases, 6. Operated upon, 4. Not operated upon, 2.
Presumed Type of Lesion. Tumor.
Presumed Location of Lesion. Right or left cerebellopontine angle.
Operations. Single or multiple at first admission, 4; died in hospital, 0. Total number of operations, 5. Total deaths, 0. Operative and case mortality, 0 per cent.
Kind of Operation. Suboccipital exploration and decompression, 3. Callosal puncture, 1.
Postoperative Complications. None.
Immediate Results. 6 cases. 4 operated upon with 0 deaths; 4 patients discharged. 2 not operated upon, 0 deaths; 2 patients discharged.

Late Results, Operative Group. 4 patients discharged. Of these:

(*A*). None Living January 1, 1922.

(*B*). 3 Lived for a Time but Subsequently Died.

1 *lived two years.*
Poor health. Helpless, bedridden.

1 *lived one and a half years.*
Result not known. No data, except death notice.

1 *lived less than one year.*
Result not known. No data.
Operation. Suboccipital exploration and decompression, 2. Callosal puncture, 1.

1 Lived for a Time but was Lost Sight of.

1 *lived less than one year.*
Poor health. Disabilities—vertigo, roaring in head.
Operation. Suboccipital exploration and decompression.

Late Results, Non-operative Group. 2 patients discharged. Of these:

(*A*). None Living January 1, 1922.

(*B*). 1 Lived for a Time but Subsequently Died.

1 *lived less than one year.*

Result not known. No data except death notice.

(*C*). 1 Lived for a Time but was Lost Sight of.

1 *lived less than one year.*

Result not known. No data.

Chart XI—PRESUMED BRAIN-STEM TUMORS.

Total number of cases, 14. Operated upon, 12. Not operated upon, 2.

Presumed Type of Lesion.

(*a*) Verified by later operation or autopsy, 2 (fibrinous basilar meningitis; internal hydrocephalus. Internal hydrocephalus; cerebral hemorrhage into ventricles).

(*b*) Presumed brain tumor ? 12.

Presumed Location of Lesion. Pons, 6. Pineal gland, 5. Brain stem (no other localization), 3.

Operations. Single or multiple at first admission, 11; died in hospital, 5. Subsequent at subsequent admissions, 1; died in hospital, 0. Total number of operations, 18. Total number of deaths, 5. Operative mortality, 28 per cent. Case mortality, 41 per cent.

Kind of Operation. Suboccipital exploration and decompression, 6. Subtemporal decompression, 4. Craniotomy (exposure of pineal gland), 2.

Postoperative Complications. Wound infection (recovery), 1.

Immediate Results. 14 cases. 12 operated upon with 5 deaths; 7 patients discharged. 2 not operated upon, 0 deaths; 2 patients discharged.

Late Results, Operative Group. 7 patients discharged. Of these·

(*A*). 3 Living January 1, 1922.

2 *living ten years or more.*

2 in good health. Disabilities—impaired vision, 1; unable to walk, 1.

Operation. Subtemporal decompression, 1. Suboccipital decompression, 1.

1 *living one to three years.*

1 in good health. Disabilities—None for one and a half years, now has headache, vomiting, blind.

Operation. Suboccipital exploration and decompression, 1.

(*B*). 3 Lived for a Time but Subsequently Died.

1 *lived five to ten years.*

1 in poor health. Disabilities—Headache, poor vision, unable to walk.

Operation. Exploratory craniotomy.

1 *lived three to five years.*

1 in poor health. Disabilities—blind, helpless, unable to walk.

Operation. Subtemporal decompression.

1 *lived less than one year.*

1 in poor health. No improvement in symptoms.

Operation. Subtemporal decompression.

(*C*). 1 Lived for a Time but was Lost Sight of.

1 *lived less than one year.*

1 unimproved in health. Symptoms unabated or worse.

Operation. Exploratory craniotomy.

Late Results, Non-operative Group. 2 patients discharge. Of these:

(*A*). 1 Living January 1, 1922.

1 *living eight years.*

Poor health. Loss of mentality, unable to walk; in institution six years.

(*B*). 1 Lived for a Time but was Lost Sight of.

1 *lived less than one year.*

Result not known. No data.

Chart XII—GENERAL SUMMARY OF PRESUMED BRAIN TUMORS.

Total number of cases, 343. Operated upon, 270. Not operated upon, 73.

Operative Group, 270 *Cases*

1. *Presumed Cerebral Tumors*, 199. Operated upon, 158. Hospital deaths, 15. Patients discharged, 143. Of these:

60 *lived beyond a three-year period.*

11 entirely well.
33 in good health.
3 in fair health.
13 in poor health.

38 per cent of the patients operated upon. 42 per cent of the patients discharged.

2. *Presumed Hypophyseal and Suprasellar Tumors*, 40. Operated upon, 19. Hospital deaths, 0. Patients discharged, 19. Of these:

13 *lived beyond a three-year period.*

2 entirely well.
4 in good health.
6 in fair health.
1 not known.

68 per cent of the patients operated upon. 68 per cent of the patients discharged.

3. *Presumed Cerebellar Tumors*, 84. Operated upon, 77. Hospital deaths, 10. Patients discharged, 67. Of these:

25 *lived beyond a three-year period.*

6 entirely well.
13 in good health.
4 in fair health.
2 in poor health.

32 per cent of the patients operated upon. 37 per cent of the patients discharged.

4. *Presumed Cerebellopontine-angle Tumors*, 6. Operated upon, 4. Hospital deaths, 0. Patients discharged, 4. Of these:

None lived beyond a three-year period.

5. *Presumed Brain-stem Tumors*, 14. Operated upon, 12. Hospital deaths, 5. Patients discharged, 7. Of these:

4 *lived beyond a three-year period.*

2 in good health.
2 in poor health.

33 per cent of the patients operated upon. 57 per cent of the patients discharged.

Totals. Of 270 presumed brain tumors operated upon, 30 died, 240 were discharged. Of these:

102 *lived beyond a three year period.*

19 entirely well.
50 in good health.
13 in fair health.
17 in poor health.
1 not known.

37 per cent of the patients operated upon. 42 per cent of the patients discharged.

Non-operative Group, 73 Cases.

1. *Presumed Cerebral Tumors*, 41. Hospital deaths, 3. Patients discharged, 38. Of these:

12 *lived beyond a three-year period.*

3 entirely well.
6 in good health.
3 not known.

31 per cent of patients discharged.

2. *Presumed Hypophyseal and Suprasellar Tumors*, 21. Hospital deaths, 0. Patients discharged, 21. Of these:

10 *lived beyond a three-year period.*

1 entirely well.
5 in good health.
3 in fair health.
1 in poor health.

47 per cent of the patients discharged.

3. *Presumed Cerebellar Tumors*, 7. Hospital deaths, 1. Patients discharged, 6. Of these:

2 *lived beyond a three-year period.*

1 entirely well.
1 in good health.

33 per cent of patients discharged.

4. *Presumed Cerebellopontine-angle Tumors*, 2. Hospital deaths, 0. Patients discharged, 2. Of these:

None lived beyond a three-year period.

5. *Presumed Brain-stem Tumors*, 2. Hospital deaths, 0. Patients discharged, 2.

1 *lived beyond a three-year period.*

1 in poor health. In institution for six years.

50 per cent of patients discharged.

Totals. Of 73 presumed brain tumors not operated upon, 4 died; 69 were discharged. Of these:

25 *lived beyond a three-year period.*

5 entirely well.
12 in good health.
3 in fair health.
2 in poor health.
3 not known.

36 per cent of patients discharged.

Such, then, is the story of our actual accomplishments, a story not so badly told when we compare it with that of other malignant conditions; for we must consider brain tumors malignant in the sense that they are all prone to local recurrence and kill certainly and rapidly even though they do not metastasize. Our study shows that from the standpoint of operability and end-results they are in a class far above carcinoma of the tongue, rectum, stomach and so forth and rank with the more favorable malignant lesions of the body. In no sense are they hopeless conditions to be viewed with pessimism, but rather conditions which promise much in the way of treatment and worthy of our future efforts.

What directions our future efforts should take may be discussed under several headings:

1. The Early Diagnosis of Brain Tumors. When we survey the histories of the patients in this series it becomes evident that outspoken symptoms of brain tumor have in the majority of cases been present for months and sometimes even for years before the patients have come to the hospital. When we study the clinical signs which they presented at the time of their admission we find that late evidences of disease, as blindness, impaired vision, paresis or paralysis of the extremities, mental disturbances, incoördination and staggering gait and so forth, have been distressingly frequent. For years 10 per cent of all patients with brain tumors came to the hospital blind; and although the number in recent years has diminished, impaired vision or blindness is still all too common. At the operating-table the vast majority of tumors exposed are large—so large as to be doubtfully operable. When we study the late results we find that the damage to the individual evident at admission is very frequently permanent in spite of so-called successful surgery. Of the comparatively few patients whose disease was cured or at least was stationary for one or more years, 12 remained permanently blind, 18 more had marked impairment of vision, 25 had paralysis of the extremities, 27 had epileptic or convulsive seizures, 8 had mental disturbances and 20 had staggering gait. Only 5 per cent of the entire number of patients with verified brain tumors may be considered well in the

sense that they have been restored to normal. It is clear that the diagnosis of brain tumor is usually made late in the course of the disease and that neurosurgeons see their patients at a time when the possibilities for successful surgical treatment are unfavorable. From the viewpoints of lessening the immediate mortality and of preventing the permanent disabilities which I have just enumerated early diagnosis is one of the most important steps necessary for our future progress. It seems unnecessary to again urge the intelligent use of the ophthalmoscope and the acquisition of at least the fundamentals of neurologic diagnosis by every practitioner and medical student; yet within the past week I have had the common experience of seeing a patient in the late stages of brain tumor treated for stomach trouble, because of vomiting, when an ophthalmoscopic examination would have revealed a choked disk. But the problem of early diagnosis is more difficult than this; for the sympoms of brain tumor which we recognize as characteristic—headache, vomiting and especially choked disk—are not early but late symptoms of the disease. It has become necessary to more clearly recognize the symptoms which antedate them if we are to greatly improve our treatment; and to this end we should direct our efforts. Moreover, should the time come when patients are sent to us in the early stages of brain tumor, new methods for the focal diagnosis of lesions will in all probability have to be devised; for our present methods, such as ventriculography, ventricular puncture, the *x*-ray and so forth, have been devised to meet our present needs—the diagnosis of late cases. Unless new methods are found we shall see a progressively increasing number of presumed brain tumors.

2. The Mortality in Brain-tumor Surgery. It must have impressed you, as it impressed me, that the mortality attending our surgical efforts has been high. In 473 cases of verified brain tumor subjected to operation the *primary mortality, i. e.,* that attending operations at the first admission, was 37 per cent; the *secondary mortality, i. e.,* attending operations at subsequent admissions, chiefly for recurrences, was 47 per cent; the *total mortality,* 46 per cent. In 270 cases of *presumed* brain tumor the

primary mortality was 11 per cent, the *secondary mortality* was 8 per cent, and the *total mortality* was 11 + per cent. When we examine into our mortality we find that it has been dependent upon a number of factors. (1) It has been dependent upon the development of the technic of intracranial procedures. In the hospital's early history, during the period when operative technic and the control of hemorrhage and of intracranial pressure were not perfected, the mortality was high. (2) It has been dependent upon the surgeon's skill and especially upon his attitude toward the treatment of lesions encountered at the operating-table. We have seen some notable examples of this. In my own experience there was a period when I seriously undertook to discover whether or not a cerebellopontine-angle tumor could be completely removed without a prohibitive mortality, although I knew that others—my betters in training, skill and experience—had failed. Even with the widest exposures, and with the most painstaking technic, I failed; but before I accepted defeat I had increased the mortality in cerebellopontine-angle tumors far beyond what it should be—and what it is at present. Repeatedly in the hospital's history surgeons have changed their attitude toward the treatment of various lesions—and almost always with a primary rise in the mortality rate. (3) It has been dependent upon the development of new procedures either for the treatment of lesions the treatment of which seemed unsatisfactory, or for the treatment of lesions hitherto inaccessible. The intracranial approach to the hypophysis serves as an example; an operation devised because I thought the transphenoidal approach was unsatisfactory. Before the operation had been perfected, before experience in its use had accumulated, the mortality in hypophysectomies was high—far higher than in hypophysectomies performed by the same method today. Generally speaking, the mortality at this clinic has depended in part upon the investigative spirit (sometimes misdirected) of its members. (4) It has been dependent upon the location and size of the lesion and the time in the course of the disease at which operation was performed, factors not peculiar to one clinic but common to all. That the location of a lesion

plays a rôle in the mortality rate is evidenced by a comparison of the deaths in the different groups of lesions. It was highest in the hands of all surgeons in brain-stem tumors, it was lowest in the cerebral or cerebellar tumors. The size of the lesion and the stage of the disease usually but not always go hand-in-hand and influence the mortality rate chiefly because of the associated intracranial tension. The difficulties in operative technic under conditions of marked pressure are well known to neurologic surgeons, as are those attending the removal of large tumors. The operative or postoperative complications, as respiratory paralysis, cerebral edema and postoperative pneumonia, are common. These difficulties in technic and these operative and postoperative complications are largely absent in cases with small lesions associated with mild grades of intracranial pressure. If we compare the mortality of the verified and the presumed tumors we find that the verified cerebral tumors showed a mortality of 35 per cent, the presumed cerebral tumors a mortality of 10 per cent, the verified cerebellar 48 per cent, the presumed 13 per cent and so on. The operative approach in both groups was the same, but the increased difficulties due to high grades of intracranial pressure and to attempts to remove large tumors combined with more frequent operative and postoperative complications were responsible for the increased mortality. To lessen them is one of the important reasons for early diagnosis and treatment.

It is obvious that in order to improve our end-results we must reduce our mortality, for, as has been indicated, 34 per cent of all patients with verified brain tumors who survived operation lived beyond a three-year period, while only 21 per cent of all patients operated upon lived for that period. With succeeding years there has been a reduction in the mortality in this series and largely by the perfection in the technic of the control, especially of hemorrhage and states of increased intracranial tension, by the selection of operations proven by experience to most nearly meet the rquirements of given lesions, and by a proper if changing attitude toward the treatment of lesions exposed at the operating-table. While, for example, the total mortality in verified and

presumed cerebral tumors has been 25 per cent, it has, in the hands of one surgeon, been 14 per cent; while the total mortality in verified and presumed cerebellar tumors has been 31 per cent, it has in the hands of one surgeon been 10 per cent, and so on. These reductions in mortality have been due to the facts that these operations—the approach to cerebral and cerebellar tumors—had become standardized in the sense that the technic had been developed and a proper attitude toward the treatment of lesions exposed had become more or less established. It is safe to say that the mortality in operations for brain tumor should today be no more than 10 to 15 per cent and may be expected to fall below this level.

3. The Late Results from the Viewpoint of Pathology. It will have been seen from the charts that the *gliomata*, the *cystic gliomata*, the *cysts*, the *endotheliomata* and the *adenomata* (of hypophysis) form in this series by far the larger number of brain tumors (89 per cent); that other lesions, as the syphilomata, tuberculomata, metastatic carcinomata and sarcomata, angiomata and so forth form together but a small per cent of the lesions (11 per cent). It is of interest to follow the subsequent histories of patients who harbored the common lesions in order to know what lesions subjected to operative therapy have yielded the most favorable late results. Studied from this viewpoint we find that of 171 *patients with verified cerebral lesions who survived operation*, 70 had *gliomata*, 25 had *cystic gliomata*, 22 had *cysts*, 28 had *endotheliomata*, 7 had *syphilomata* and 19 had a *variety of infrequent lesions*. Of the 70 patients who had *gliomata*, 5, or 7 per cent, lived beyond a three-year period; of the 25 who had *cystic gliomata*, 11, or 44 per cent, lived beyond a three-year period; of the 22 who had *cysts*, 11, or 50 per cent, lived beyond a three-year period; of the 28 who had *endotheliomata*, 16, or 57 per cent, lived beyond a three-year period; and of the 7 with *syphilomata*, 4, or 57 per cent, lived beyond a three-year period. Of the patients with verified cerebellar tumors, 11 per cent of those with gliomata, 79 per cent with cystic gliomata and 70 per cent with cysts, lived beyond a three-year period. A far higher percentage of patients with cerebellar

tumors survived patients with cerebral tumors of the same kind according to our older pathology; and the question arises—which I shall subsequently discuss—whether we more completely remove gliomatous tumors in the cerebellum or whether we are dealing with different kinds—perhaps more benign types—of tumors? Summarizing the entire series of patients with verified tumors who survived operation we find that of 97 patients with gliomata, 8, or 8 per cent, lived beyond a three-year period; of 39 patients with cystic gliomata, 22, or 56 per cent; of 51 patients with cysts, 25, or 50 per cent; of 43 patients with endotheliomata, 23, or 53 per cent, and of 28 patients with adenomata (hypophysis), 14, or 50 per cent, lived beyond a three-year period. From the viewpoint of pathology the cystic gliomata, the endotheliomata, the cysts and the hypophyseal adenomata give almost equally good late results (56 per cent, 53 per cent, 50 per cent, 50 per cent respectively), while the solid gliomata, wherever they may occur in the brain, give poor end-results (8 per cent). Since the solid glioma is the most frequent brain tumor, comprising 38 per cent of all the verified lesions in the series, this is a matter of great importance and warrants some further study.

4. The Late Results from the Viewpoint of the Location of Lesions. Viewed from the standpoint of the location of lesions there are also marked differences in the end-results. If we take as a basis of comparison the *number of patients operated upon who lived beyond a three-year period* we find that 20 per cent of the patients with cerebral, 23 per cent with hypophyseal, 34 per cent with cerebellar, 17.5 per cent with cerebellopontine-angle and 0 per cent with brain-stem tumors lived beyond a three-year period. In such a comparison the primary mortality, which admittedly has been too high in certain groups of cases (hypophyseal and cerebellopontine), plays an unfairly important rôle. If we eliminate for the moment the primary mortality and base our comparison upon *the number of patients surviving operation who lived beyond a three-year period,* we find that 28 per cent of patients with cerebral, 39 per cent with hypophyseal, 49 per cent with cerebellar, 41 per cent with cerebellopontine-angle and 0 per

cent with brain-stem tumors lived beyond a three-year period. It thus appears that tumors which have their location in the cerebellum are the most favorable from the viewpoint of late results, that those occurring in the cerebellopontine-angle, hypophysis and cerebrum are successively less favorable, while those occurring in the brain stem are absolutely unfavorable. Aside from the mortality the prognosis, so far as location is concerned, is dependent upon the pathology and the accessibility of the lesion. The comparatively poor prognosis of cerebral and brain-stem tumors lies in the fact that a high percentage are gliomata which in the cerebrum are often inaccessible because subcortical, and which in the brain stem are at the present time quite inaccessible. (Of 33 verified brain-stem tumors operated upon there were 5 partial removals, 1 evacuation of a cyst and 2 removals or partial removals of pineal gland tumors.)

5. The Operability of Brain Tumors. The foregoing considerations bring us to the question of the operability of brain tumors, a subject which may be discussed from various viewpoints: (*a*) From that of mortality, (*b*) of location and accessibility, (*c*) of pathology and (*d*) of operative procedures or attitude toward treatment.

(*a*) We have discussed the question of mortality and have commented upon the fact that in this series it has been high—though in general not so high as in many other series of cases reported. But we have also pointed out that the mortality has been reduced to a comparatively low level and is capable, with earlier diagnosis, of a still greater reduction. Our surgical technic has outstripped our diagnosis and our pathologic knowledge, and we may, I think, safely leave the question of mortality without further comment. There is, however, one interesting fact in our mortality which bears upon the operative treatment of tumors. A study of our verified cerebral tumors shows that operative measures without the removal of tumors is attended by a higher mortality than operations with removal of tumors. Thus in 91 cases operated upon *without removal* of tumors there were 57 deaths, a mortality of 62 per cent; while in 152 cases operated upon *with*

removal of tumors there were only 29 deaths, a mortality of 19 per cent. Sixty-six per cent of the total mortality in this group occurred therefore in the 38 per cent of the patients operated upon whose tumors were not removed. In the group of hypophyseal tumors a 50 per cent mortality followed simple decompression; in the cerebellar tumors, if we eliminate 3 deaths due to post-operative meningitis, 12 of the 23 primary deaths followed non-removal of tumors, 11 deaths the removal of tumors; in the cerebellopontine-angle tumors exploration and decompression without removal of the tumor was followed by a mortality of 83 per cent—higher even than that following *total* enucleation. In the brain-stem tumors, which are so often inaccessible and consequently not removed, the mortality was higher with non-removal than with removal. This apparently anomalous finding is explained in part by the fact that cases in which tumor removal has not been attempted have been cases in which the tumor was either not accessible or if accessible was so large and the patient in such a late stage of the disease that removal was not advisable. In these cases a high mortality is expected whatever the procedure adopted. But this does not explain it entirely; and the fact remains that, excluding the above groups, partial or complete removal of tumors has been attended by less mortality than craniotomies without removal of tumors. I have stated elsewhere that the removal of large tumors has influenced detrimentally the mortality in this series; and this is true—but because of hemorrhage and its attendant shock. But the failure to remove tumors also affects the mortality detrimentally and because of reasons not altogether clear, but it seems, because the dislocation of the brain through a cranial opening without sufficient relief of tension such as might be obtained by tumor removal causes pressure upon or interference with the function of or edema of important structures with consequent cerebral compression, respiratory paralysis and so forth.

(*b*) With regard to the operability of brain tumors as influenced by their location and accessibility, we have indicated in a preceding paragraph that the location of lesions has influenced

both the mortality and end-results; the mortality because of the difficulties in approach and the complications attending attempts at removal, and the end-results because of the nature of the lesions (glioma). When we consider the various groups of tumors from the standpoint of location we find that the superficial cerebral, the hypophyseal, the cerebellar and cerebellopontine-angle tumors are usually accessible, although not always sufficiently so to permit of radical extirpation. The subcortical cerebral gliomata and the brain-stem tumors on the other hand are, in comparison, inaccessible. The true subcortical tumors of the cerebrum are the solid gliomata, the cystic gliomata and the cysts. With the exception of certain regions which we call "silent," because they seem to have no definite function, the transcortical removal of subcortical solid gliomata involves interference with important functions and is responsible for some of the disabilities such as aphasia, paralysis, etc., which we have seen in the tables of our late results. Moreover, we have but one instance in which a patient with a subcortical solid glioma has survived attempted removal for a period of three years. The usual period of life has been less than one year, the tumors inevitably recurring. So, too, when we consider the brain-stem tumors we find that they are of all tumors the most inaccessible, and are commonly gliomata. Operation has been attended by the highest mortality of any group in this series and no case operated upon has lived beyond one and a half years. Dandy has twice brilliantly succeeded in exposing and removing tumors of the pineal gland in this series, but without satisfactory permanent results. In view of the above considerations the questions arise: (1) Is it worth while to attempt removal of solid subcortical gliomata when at the present time it may be shown that with simple decompression the results from the standpoint of comfort and duration of life are quite as good? (2) Is it worth while to operate upon brain-stem tumors at all when the diagnosis of such tumors seems certain? I am not prepared to answer these questions negatively, but raise them in order to point out that if we wish to progress in the treatment of these tumors we must devise methods other than those we have used in the past.

(*c*) To discuss fully the pathology of tumors as it relates to their operability would take us far beyond our time and we can at present refer only to a few points which, it seems to us, are of importance from the standpoint of our future progress. Generally speaking, the tumors which occur most frequently—the *gliomata, cystic gliomata, cysts, endotheliomata* and *adenomata*—have this characteristic in common—that they all show a marked tendency to recur. Radical removal, then, would be the ideal surgical procedure for their treatment—a subject which I shall presently discuss. In common they show also, but far less frequently, the opposite tendency—the tendency to become quiescent and self-limited. We have an example of a solid glioma which, because of its size, was not removed but which was verified by the removal of tissue for diagnosis, which has become quiescent and undergone calcification, the patient being alive and well at present, eight years after operation. We have similar examples of endotheliomata in patients alive eleven years, of hypophyseal adenomata in patients alive ten years and so forth. Individually the various types of lesions show marked dissimilarities. The *endotheliomata* are characteristically slow growing, circumscribed, enucleable tumors, by far the most favorable from the standpoint of radical removal; but our study shows that they have recurred with too great frequency. It is easy to explain their recurrence when arising from the falx, the tentorium or in the cerebellopontine-angle on the basis of incomplete removal, for we know that often they are incompletely removed. It is not, however so easy to explain the local recurrence which we sometimes observe when, in tumors arising from the dura over the convex surface of the cerebral hemispheres, we have removed not only the lesion but what we consider a wide margin of surrounding dura. Three possibilities suggest themselves: (1) That multiple tumors may arise in a relatively circumscribed area and the subsequent lesions are not recurrences but new tumors. This may be an actual possibility. (2) That the secondary lesions may be the result of the implantation of tumor cells from the original tumor upon the meninges in its neighborhood. Implantation lesions we know

occur in the gliomata. (3) That the secondary lesions may arise from the direct extension of tumor cells in a macroscopically normal dura analogous to the extension of carcinoma cells in the lymphatics. So far as I know no studies by means of serial sections have been made to determine this. The *adenomata of the hypophysis* are, like the endotheliomata—but perhaps to a less degree—circumscribed tumors which rarely break through their capsule and invade the surrounding brain substance. They show some tendency to undergo cystic degeneration, though not the same tendency that gliomata do. They grow relatively slowly (the so-called malignant adenomata are exceptions) and tend to be self-limited in their growth. All these factors in their natural life history favor the patient and the surgeon. It would be idle to suppose that by a transphenoidal approach an adenoma is actually removed. By an intracranial approach under direct vision we have been able to remove a far larger proportion of the tumor, but even with this approach we probably rarely entirely remove the lesion. Although we have accomplished some very important results—the preservation or restoration of vision and the relief of discomforts—we have not, or probably only rarely, radically removed the lesion; and yet have obtained favorable end-results from the standpoint of three- to five-year cures. (In 6 of survivors the tumor was not removed.) But we have not prevented relatively frequent recurrences and should therefore study further the pathology and treatment of these tumors. The *hypophyseal* and *suprasellar cysts*—the cyst adenomas, the cysts of Rathke's pouch and the infundibular cysts—show a more rapid growth and a higher tendency to recurrence. Four of the nine cases of cyst which survived operation returned to the hospital within a year for recurrences and no patient with a cyst lived for three years. This again calls for further study if we are to succeed better in the future.

The gliomata, the cystic gliomata and certain of the cysts (those containing a straw-colored fluid which coagulates on standing) form a most interesting group from the standpoint of their pathology. The solid gliomata, whether they occur upon the surface or sub-

cortically, are characteristically infiltrative tumors, without well-defined margins. They most nearly resemble malignant tumors elsewhere and, as a rule, are rapidly growing. They are very prone to recurrence both early and late; the vast majority recur—in the sense that they reproduce their symptoms—within a year; but we have observed patients free from symptoms and apparently well for a period of six to seven years after removal of the lesion suffer from a late and rapidly fatal recurrence. While the vast majority of gliomata are infiltrative there has occurred in this series an occasional example—if our pathologists are correct—of a slow-growing, circumscribed, enucleable glioma. One patient is at present living and well thirteen years after the removal of such a tumor and two patients are living and apparently well eight and five years after decompressive craniotomy without removal of the tumors. Certain of the solid gliomata undergo cystic degeneration and explain the cystic gliomata which we not infrequently meet at the operating-table. We have observed that this is so, for tumors which at the first operation were solid have at subsequent operations shown the characteristic picture of cystic gliomata. Other solid gliomata apparently never in their life history undergo cystic degeneration. The process of cystic degeneration of gliomata may go on to the development of those cysts which have no more than a thin, friable, more or less gelatinous cyst wall containing within it a clear or opalescent fluid which coagulates on standing. We have observed all stages of the development of these cysts—from the glioma which was largely solid to the cyst which contained but the tiniest nubbin of glioma in the cyst wall. Until recently the pathologic diagnosis of glioma was all-embracing; but for years neurosurgeons have recognized that clinically there were differences in the tumors diagnosed pathologically as gliomata—that some remained solid, others were prone to cystic degeneration and might eventually give rise to cysts—and that there was, as our tables show, the greatest difference in their prognosis from the standpoint of late results. It has seemed as if the gliomata which undergo cystic degeneration, unlike those which remain solid and infiltrative, are more or less

self-limited in their growth and that cystic gliomata and cysts represent the degenerative, more or less terminal stage in their life history. That our operative efforts in these tumors have been comparatively so successful has been, I think, due more to this fact than to our actual operative procedures. More recently Cajal and his pupils P. del Réo-Hortega and N. Achúcarro have done some work on neuroglial tissue, a continuation of which promises to explain in part at least the clinical differences in these tumors. They have found that neuroglial tissue is not made up of one but of at least four types of cells and that these different types of cells vary in size, shape and staining reactions. The subject has been taken up in this country by Bailey, of Cushing's Clinic, and with the idea, I think, of correlating the type of cell with the clinical variety of tumor. Needless to say this and similar work is of the greatest importance, for it will lead to a clearer understanding of the commonest of brain tumors and may lead to therapeutic procedures far more successful than those we possess at present.

It has just been said that the cystic gliomata and the cysts represent degenerative stages in the life history of certain solid gliomata. They are not, however, impotent. The cystic gliomata show a tendency to recur, the cysts to refill after evacuation. It is not certain in a few instances that cystic gliomata, presumably in a degenerative stage, have not, like tumors elsewhere in the body, been stirred into activity by our operative manipulations. This matter also requires further study, as does the secretory lining of the cysts.

(*d*) Our operative procedures, our attitude toward the treatment of lesions exposed at the operating-table, have naturally depended upon three considerations: Upon the mortality, upon our knowledge of pathology and upon the injury to important structures or impairment of important functions. Our aim has been, just as in tumors elsewhere, the radical extirpation of the lesion. But only comparatively rarely has it been possible to achieve our aim. We have been enormously handicapped by the above considerations. Certain tumors (cerebellopontine-angle) favorable for rad-

ical extirpation by their nature and more or less accessible can be radically removed; but, at the present time, with such a prohibitive mortality as to make their radical extirpation inadvisable. Certain other tumors (hypophyseal adenomata or cysts), favorable from the standpoint of their pathology, may not be radically removed, for their total removal would involve removal of a gland which, until we have more definite information to the contrary, we must consider essential to life. Still other tumors (gliomata) might be—indeed have been—radically removed in the sense that they have been removed with a surrounding zone of apparently normal cortex, but at the cost not infrequently of complete aphasia or hemiplegia or the loss of other functions which renders the patient's life less endurable than it was before. Moreover, our records fail to show that such radical extirpations have led to better results from the standpoint of recurrence. For similar reasons we are not justified in the indiscriminate ligation of large bloodvessels, rather we must carefully preserve them, for their ligation may and has caused softening of parts of the brain supplied by them with resulting loss of important functions and even death. Our inadequate knowledge of the pathology of cerebral tumors has been detrimental to our intelligent treatment of these tumors. We have not been able to define the limits of gliomata, we have not been able to prevent the refilling of cysts; indeed, we have not been able to adequately deal with the dural endotheliomata occurring over the convexity of the cerebrum, the most favorable of all brain tumors from the standpoint of pathology and accessibility. In view of all this our attitude toward the treatment of lesions has been to so treat them that there will be the lowest mortality consistent with attempted removal and with the least resultant disturbance of important functions. There have been rather frequent but temporary exceptions to this attitude, the total beneficial result of which has been to advance neurosurgery along many lines; the total detrimental effects, an increased mortality rate and a higher percentage of postoperative disabilities. Based upon this attitude our operative procedures have, up to the present time, resulted in the vast majority of cases, not in radical

but in partial extirpation of lesions. We have radically removed some of the dural endotheliomata over the convexity of the cerebrum; we have in rare instances radically removed tumors elsewhere; but in general we have treated inadequately, in the sense that we treat tumors elsewhere in the body adequately, the gliomata, the cystic gliomata, the cysts, the endotheliomata and the hypophyseal adenomata. That we have achieved such good results as I have indicated is due in large measure to the relief of intracranial pressure and to the nature of the tumors—not to the radical extirpation of the tumors. It is evident that we must think seriously of the treatment of lesions exposed at the operating-table, for unless we do so our percentage of local recurrence will remain high in the future as it has in the past. Two possibilities looking toward the future betterment of our treatment immediately suggest themselves—earlier diagnosis in the hope that radical extirpation may be possible in tumors which are small, and a better understanding of the pathology of tumors in the hope that such knowledge may enable us to more intelligently treat them.

One could not well leave this phase of the subject without reference to *x*-ray and radium therapy in the treatment of brain tumors—either alone or in combination with operative therapy. The present series does not permit us to express an opinion on the efficacy of these agents. In the later cases of the series deep *x*-ray and radium treatments have occasionally been used, but so inconstantly and with such inaccurate records as to be valueless for purposes of study. We can say, however, that in two patients with gliomata so large as to be considered inoperable and therefore not removed, radium treatments were associated with such improvement that for a year and a half and two years we considered them well. There was a gradual disappearance of the hernia incident to the decompression which might be interpreted as due to the disappearance of the tumor. Unfortunately, however, their period of good health did not continue; there was a rapid return of symptoms and the patients died of their disease. So, too, we have seen apparent improvement in cerebellopontine-angle tumors which have been partially removed; but here the

evidence is not so clear. One disastrous experience we have had—a case of cerebellopontine-angle tumor which promptly died with symptoms of grave toxemia following the insertion of radium into the capsule of the tumor. We are aware of the reports of others on this subject, and we bring it up not because of any contribution we can make but because we think it warrants the careful study by some enthusiast in the hope that this form of therapy may become a valuable instrument in our armamentarium.

The Presumed Brain Tumors. Our paper is already too long, yet we would like to say something of the presumed tumors. On January 1, 1922, 343 cases, or approximately 40 per cent of the entire series, belonged to this group; a statement not strictly accurate, for of the list prepared at the beginning of this study, 16 cases (9 presumed cerebral, 5 presumed cerebellar and 2 presumed brain-stem tumors) have been verified. In these 16 cases a tumor was not present and they rightly should be excluded from the series. It is interesting, however, to note the conditions which simulated tumor sufficiently closely to warrant operation. Of 9 presumed cerebral tumors which have been verified and which failed to show a tumor, 4 were pseudotumors—examples probably of serous meningitis; 2 were cerebral arteriosclerosis and 1 each chronic basilar meningitis, sinus thrombosis and cerebral hemorrhage extending into the ventricles. Of the 5 presumed cerebellar lesions 4 were internal hydrocephalus due to causes other than brain tumor and 1 a cerebellar hemorrhage with extension into the ventricles. Of the 2 presumed brain-stem tumors, 1 proved to be a chronic basilar meningitis with internal hydrocephalus and 1 a cerebral hemorrhage with extension into the ventricles and internal hydrocephalus. While these cases have proven not to be brain tumors a far larger number of the hospital's presumed tumor list has been shifted into the list of verified tumors. The presumed tumors, therefore, are a changing group, a considerable number eventually through secondary operation or autopsy being advanced to the verified group, a smaller number dropping out of the tumor list because of other lesions and a varying number remaining because of our failure to verify their

lesions. Of this last group there were on January 1, 1922, 327 cases. Of these 254 were operated upon, of which 18 died in the hospital without an autopsy examination; 73 were not operated upon, of which 4 died; 305 patients, therefore, were discharged from the hospital. An examination into the subsequent histories of these patients shows that 105 were living January 1, 1922; 103 had lived varying periods but had died without their lesions being verified; and 97 had lived varying periods but had eventually been lost sight of. The story of the posthospital life of these patients suggests many interesting speculations in regard to differential diagnosis which time will not permit us to discuss. But in addition to speculations there are two outstanding facts which seem evident from a study of these cases—the beneficial effects of decompressive measures in conditions associated with increased intracranial pressure and the low mortality attending these operative measures. Many of the most brilliant examples of therapeutic relief in the entire series of cases are found among the presumed tumors. Patients with intense discomforts, with failing or absent vision, with conditions which rendered them helpless and bedridden, have been restored to normal and have had long periods of uninterrupted health. The mortality has been 7 per cent, a mortality which today is even lower. The point I wish to make is that though we may be unable to make a differential diagnosis, we have valuable and safe surgical methods of alleviating the discomforts and averting the tragedies of conditions associated with increased intracranial tension, and should therefore not delay in using them pending a positive diagnosis of tumor.

Summary and Conclusions. 1. In an effort to arrive at a more accurate knowledge of what we have accomplished in the surgery of brain tumors, I have studied the late results of surgical therapy in a series of 828 cases which have been admitted to the Johns Hopkins Hospital from the years 1889 to 1920 inclusive. A personal letter, not the stereotyped questionnaire, was sent to every patient whom we could not see in order that we might get more accurate information of his condition. It is admittedly difficult to judge of patients' conditions from their letters. Ail-

ments which are essentially unimportant are often magnified, and the reverse. So far as we have been able we have accurately set forth the end-results in this series. Only those patients have been called "well" who have no disabilities or discomforts attributable to their previous condition, who are pursuing their usual occupations and who state that they are in excellent health. Those are called in "good health" who state that they are in good health but who have conditions or disabilities attributable to their previous illness which may or may not interfere with the resumption of their former occupations. Those are called in "fair health" who get along with more or less discomfort but are seriously handicapped because of their disabilities. Those are called in "poor health" who suffer discomforts and are more or less completely incapacitated.

2. Of the series of 828 cases, 485, or approximately 60 per cent, have been verified by operation or autopsy, and we know the location and nature of the lesion; 343, or, more correctly, 327, or approximately 40 per cent, are unverified or presumed brain tumors. Of the 485 *verified brain-tumor cases* 473 were operated upon once or repeatedly with a primary mortality of 37 per cent. Of the 297 patients who were discharged, 102 (21.5 per cent of the patients operated upon; 34 per cent of the patients discharged) *lived beyond a three-year period,* and of these, according to the above criteria, 23 *were entirely well,* 47 *in good health,* 15 *in fair health* and 17 *in poor health;* 59 patients *lived from one to three years,* and of these 9 *were well,* 12 *in good health,* 8 *in fair health,* 28 *in poor health* and 2 not stated; 115 *lived less than one year,* and of these 19 *were well,* 5 *in good health,* 3 *in fair health,* 85 *in poor health* and 3 not stated. In 21 cases the end-result is unknown. If we consider only the 102 patients who lived beyond a three-year period we find that only 5 per cent of the entire number of brain-tumor patients operated upon were restored to perfect health, while 10 per cent more enjoyed good health. It is to be emphasized that in a summary such as this no adequate idea can be given of the relief afforded to brain-tumor sufferers, a relief which may be immeasurable to patients whom we classify as in "fair" or in "poor health."

3. Similarly summarized, 270 of the 343 presumed brain-tumor cases were operated upon once or repeatedly with a mortality of 10 per cent. Of the 240 patients discharged, 102 (37 per cent of the patients operated upon; 42 per cent of the patients discharged) lived beyond a three-year period, and of these 19 were entirely well, 50 in good health, 13 in fair health, 17 in poor health and 1 not known; 37 lived from one to three years, and of these 6 were well, 11 in good health, 13 in poor health and 1 not known; 101 lived less than one year, and of these 5 were well, 3 in good health, 84 in poor health and 9 not known. The lesions in 16 of this series of patients have since been verified and were found not to be brain tumors; but it is evident that a large proportion of the patients in this group, especially those dying within a one-year period, suffered from brain tumor.

Setting aside all speculation regarding this group of presumed tumors the outstanding fact of importance for our present purpose is the beneficial effects which have followed decompressive measures in conditions associated with increased intracranial pressure and whether due to tumor or not.

4. A review of the late results in the verified tumor series shows a very high percentage of permanent sequelæ which often amount to incapacitating disabilities. They include blindness or various degrees of impairment of vision, paralysis of one or more extremities, aphasia, convulsive or epileptic seizures, impaired mentality and incoördination or staggering gait. The number of patients who may be considered well is indeed very small. Of the entire series of 297 patients who were discharged and without regard to the length of time they lived, 51 may be considered well. All the others had sequelæ more or less serious in nature. The great majority of patients came to the hospital with the conditions which we have termed sequelæ; and in many instances these were improved or caused to disappear as a result of our operative procedures; a certain number were produced as a result of our operative efforts and a further number were due to recurrences or to a continuation of the disease. But the fact remains that brain tumors may and often do produce permanent damage to

the individual which persists in spite of successful operative therapy. It is an added reason for early diagnosis and treatment.

5. The operative mortality in this series has been high. In the group of verified brain tumors *the total mortality* attending operations done at the first and all subsequent admissions has been 46 per cent. In the presumed brain tumors the total mortality has been 11 per cent. Knowing the part the Johns Hopkins Hospital has played in the development of neurologic surgery, the mortality is not surprising. It has been associated with the early development of the technic of intracranial operations, with the development of new approaches to intracranial lesions and with an attitude of mind which has tempted surgeons to undertake radical procedures in the hope of curing a higher percentage of tumors. It has been dependent also upon the size of the lesions and the stage in the disease at which operation was performed, factors of great importance in the hospital's early history when the majority of brain-tumor patients came in the late stages of their disease. Year by year the mortality, especially in operations which have been fully developed and directed toward lesions the safe treatment of which has been established, has steadily diminished until now it has reached a 10 to 15 per cent level. It is safe to say that our operative technic has outstripped both our diagnostic ability and our pathologic knowledge.

6. The late results in this series have depended upon the primary mortality, upon the pathology and the location and the operative treatment of the lesions. Viewed from the standpoint of pathology the common brain tumors in this series were the gliomata, the cystic gliomata, the cysts, the endotheliomata and the hypophyseal adenomata. Only 8 per cent of the patients with gliomata lived beyond a three-year period, while 56 per cent of those with cystic gliomata, 50 per cent with cysts, 53 per cent with endotheliomata and 50 per cent with adenomata lived beyond the same period. Viewed from the standpoint of location, not a single patient with a brain-stem tumor lived beyond a three-year period; while 28 per cent of those with cerebral, 39 per cent of those with hypophyseal, 49 per cent of those with cere-

bellar and 41 per cent of those with cerebellopontine-angle tumors lived beyond the same period. Viewed from the standpoint of operative treatment or operability we have been handicapped by various difficulties—the difficulties attending inaccessibility, as in the subcortical gliomata, brain-stem and cerebellopontine-angle tumors; the difficulties due to insufficient pathologic knowledge; and the difficulties, or rather complications, attending attempts at too radical extirpation, such as aphasia, paralysis, deprivation symptoms and so forth. As a result we have failed to *radically* remove any of the common brain tumors with the possible exception of the dural endothelioma arising over the convexity of the cerebrum, and our records show in consequence a very high percentage of recurrences.

In view of all this have we cause for discouragement? Rather a study of this series has put me in a more happy frame of mind than I previously possessed, with uncertain knowledge. Feeble as our efforts may have been I am now aware that they have achieved some remarkable results, in the cure, in the restoration to good health and in the relief from suffering of conditions which almost inevitably are quickly fatal and which twenty-five or thirty years ago were quite hopeless. I have a clearer conception of the problems concerned in our future progress, problems which have to do with earlier diagnosis, a better knowledge of pathology and a clearer conception of treatment. Brilliant contributions have been made but lately, contributions which are in line with our needs for progress. Perhaps even more important a new epoch, as Bailey says, has been inaugurated in neuropathology by the contributions of Cajal and his pupils. We stand on the threshold of great events. We may stand, I think, unashamed of the past, unafraid of the future.

PRIMARY INOCULATION TUBERCULOSIS OF THE SKIN WITH METASTASIS TO REGIONAL LYMPH NODES[1]

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During the past eight years there have come under my observation in the material of the Section of Dermatology and Syphilology of the Mayo Clinic, 10 cases of undoubted and 2 of probable inoculation tuberculosis of the skin, which constitute, as a group, a definite but unfamiliar type of the disease. I feel sure that a better acquaintance with the clinical characteristics of the lesion to be described would result in the identification of more cases, especially by those who as surgeons, internists, pediatricians and roentgenologists are required to deal with superficial tuberculous adenopathies. It has been my own experience that the demonstration of illustrative cases from this series before the staff of the Mayo Clinic has resulted in the identification of new examples, several of them among physicians and veterinarians. I am indebted to the Mayo Clinic for permission to use the case material here presented, including the photographs.

Inoculation tuberculosis of the skin is known to the majority of physicians as the so-called postmortem wart, or verruca necrogenica, a local lesion in the skin usually interpreted as the reaction of a resistant person to inoculation with tubercle bacilli—in other words, a superinfection. The animal homologue, in which the infected guinea-pig becomes immune to glandular metastatic

[1] Read October 1, 1924.

tuberculosis on a second inoculation with tuberculosis bacilli, although a local lesion develops, is familiar to experimental workers with this disease. Tuberculosis verrucosa cutis should then, theoretically at least, be the typical reaction of the previously-infected adult to a cutaneous inoculation, and involvement of adjacent lymphatic structures, or systemic infection, should be and is rare from this type of lesion. Inoculation tuberculosis of the skin with metastasis to lymph nodes and systemic infection should, in theory, be possible only in infancy or early childhood before systemic infection has rendered the individual resistant.

That this immunological rule cannot be applied too strictly to the human problem of inoculation tuberculosis has been evidenced by the gradual appearance in the literature of a group of reports describing primary tuberculous inoculation and lymphatic metastasis, in some cases with generalization of the infection, in adults who could scarcely have escaped a previous tuberculous infection. Naturally enough, most of the reported cases of this type of tuberculosis are in infants and children. But the existence of a group of cases in supposedly resistant adults indicates that the problem of tuberculous immunity is, like that of resistance to syphilis, not to be summed up by presupposing a resistant or susceptible host and a standard organism, but involves, as Jadassohn[1] well expressed it, an almost infinite range of interplay between the susceptibilities of the host and the virulence or avirulence of strains of infecting tuberculosis bacilli. The complexity of the problem is indicated by the fact that in one person a subcutaneous inoculation may result in an indolent inflammatory lesion like the verruca necrogenica, with another in the formation of a few tubercles in the fat at the inoculation site and a rapidly developing tuberculous adenopathy, and in a third in violent inflammatory reaction at the point of entry, which destroys all traces of the organisms but does not occur in time to prevent lymphangitis and adenitis above the lesion.

Clinically, tuberculosis verrucosa cutis and primary inoculation tuberculosis of the type here described can be quite sharply differentiated from one another. The verrucous form consists of a

warty horny inflammatory papule with papillomatous villi studding the surface. On pressure small amounts of pus can sometimes be made to exude between the horny villous projections. There is little deep infiltration, most of the activity being confined to the upper corium in association with the verrucous changes in the epidermis. In the type of inoculation tuberculosis here discussed there is no verrucous hypertrophy. The essential pathological lesion is a tubercle rather deeper than that in the verrucous form, better defined and less involved in general tissue reaction. The lesion clinically is usually flat, a group of miliary nodules about a central slightly depressed scar or superficial ulcer. In a few cases there may be deep induration and some swelling, but, as a rule, even these are absent. It is the inconspicuousness of the inoculation primary that so often permits it to escape attention in the more active treatment of the consequences.

THE LITERATURE. The report by Tscherning[2] before the 1st session of the Congress for the Study of Tuberculosis at Paris, in 1888, furnishes one of the early examples of the type of tuberculous infection here described. A servant attending a tuberculous master wounded a finger with a fragment of sputum cup. Glandular involvement followed and it was necessary to amputate the finger and remove the affected glands, with ensuing complete recovery. Tubercle bacilli were demonstrated in the tendon sheath. Lennander,[3] in 1889, reported on a tuberculous inoculation apparently following vaccination in early childhood. Hartzell,[4] in 1898, reported 3 unusual examples of inoculation tuberculosis of the hand and fingers, but the lesions were apparently of the verrucous type. Jadassohn, in his authoritative and complete review of tuberculosis of the skin in the *Mracek Handbuch* (1907),[5] mentions in brief descriptive terms the types of inoculation tuberculosis of the skin designated as tuberculous chancre and epithelioma-like tuberculous indurated ulcers; but the picture of primary inoculation as here described was evidently not then clear-cut even to an author of such large experience. In 1909 Escherich[6] reported an inoculation tuberculosis of the cheek in a child as part of his consideration of inoculation

portals for the disease in nurslings. Epstein (1912)[7] described 2 cases of inoculation tuberculosis of the ear in children following puncture for ear-rings. These cases were characterized by fulminating local reaction and the destruction of the lobule of the ear, but no generalization of the process. In 1913 Holt[8] reported a case of tuberculosis of the foreskin and penis, with fatal outcome from tuberculous meningitis following ritual circumcision. He summarized the earlier literature of this form of inoculation tuberculosis, which included an instance in which one person had been responsible for the infection of ten children by this method. Of the 41 cases considered, 16 had died and 13 recovered, the remainder being lost sight of. The local tuberculous reaction appeared within a week, glandular involvement within two to three weeks and systemic generalized infection, if it occurred, being apparent about the third or fourth month. The best results followed the removal of affected lymph nodes. Most of the cases were regarded as syphilitic infections at the outset.

A wave of reports and references to the literature, about 1910 to 1914, includes those of Brault,[9] Curshmann,[10] Hamburger,[11] and Boeck[12] of vulvar tuberculosis in children with inguinal adenitis, the infection following playing on infected floors; of tuberculosis inoculated upon eczematous lesions reported by Baumel.[13] An inoculation of an eight-weeks-old child upon the forehead was reported by Scheltema,[14] and the case of a child, aged fifteen months, who developed a tuberculosis primary upon the thumb, with a large axillary bubo, was reported by Boeck.[15] Chancellor[16] described 2 excellent cases of primary inoculation tuberculosis, 1 of them from the practice of the late John B. Murphy. In 1 case the primary lesion on the cheek, which was followed by glandular metastasis, was directly traced to the playful bite of a nurse who was in the habit of fondling the young child. On examination her sputum was found to teem with tuberculosis bacilli. In the other instance a child's cheek was infected from a pin scratch, the offending implement being carried between the lips of a tuberculous uncle who often fondled and kissed the child and who had formed the habit of carrying a pin between his lips at the com-

missure. Lipschutz, in 1914,[17] discussed the possibility that local inoculation of the skin might be traced not infrequently to avian tubercle bacilli, and emphasized the large number of organisms to be found in the tissue of such lesions. In 1914 Romer [18] stated that the study of the question of tuberculous infection through the skin was still in its beginning and that its frequency could not, therefore, be estimated.

In 1921, following the hiatus of the war, Ravenel[19] described 3 examples of inoculation tuberculosis, in 1 of which the accidental incision following cleansing with mercury bichloride healed and did not break down for three weeks. None of these cases seems to have been accompanied by glandular metastasis, however. In the same year Haldin Davis[20] reported a case of inoculation tuberculosis following a cat-bite. Dietl[21] described an excellent case in which a sixteen-months-old child, whose mother had tuberculosis, was brought to the hospital for examination as a precautionary measure. The child was normal and the von Pirquet and three subcutaneous tuberculin tests were all negative. Two months later the child was again brought to the hospital with an impetigo of the feet and an ulcer 1.5 x 2 cm. on the back. A large mass of glands had appeared in the left axilla following the development of the ulcer. On excision the lesion was found to be tuberculous. The von Pirquet test was now positive, but there was no other evidence of systemic tuberculosis. In 1922 Lutz[22] presented an excellent summary of tuberculosis of the skin, with a degree of attention to primary cutaneous inoculation which indicates the growing appreciation of the interest and importance of this aspect. Hochstetter,[23] in 1923, reported an example of verrucous tuberculosis on the wrist with what he believed might have been evidence of generalization in the form of tuberculous epididymitis. Joyce,[24] in 1923, described 2 clear-cut cases, 1 a mother inoculated on the chin and her child on the cheek, the source of the infection being apparently the tuberculous father. The most recent report is that of Nixon and Rendle Short[25] (1923), in which 4 cases of so-called tuberculous chancre are described. The first was that of a mother who sustained inocu-

lation on the chin with formation of a papule and development of a submental adenopathy, apparently from the kiss of her tuberculous son. The second was a child, aged six years, who, following a cut over the patella which did not heal for six months, developed an enlarged gland in the groin. Tuberculosis was demonstrated in both lesions and uneventful healing followed excision of ulcer and gland. The third patient, a child, aged thirteen years, struck the cheek on a desk, followed by an inflammatory reaction of the eye and the appearance of a hard nodule at the outer canthus. What seemed to be miliary tubercles appeared along the palpebral conjunctiva and the nodule broke down. On excision it was found to be tuberculous and recovery followed. The fourth case is of some interest because the nodule on the upper lip, which followed a bruise upon a small vesicle at that point, rapidly enlarged but responded promptly to administration of neoarsphenamin, on the supposition that the lesion was a syphilitic chancre. On excision the lesion was found to be tuberculous.

Efforts to ascertain the frequency of primary inoculation tuberculosis of the skin have resulted only in the finding of a quotation by Epstein from a report by Ghon,[26] of 2 cases of caseous tuberculosis of the preauricular nodes in 184 autopsies on children. In these cases there seem to have been signs suggestive of a cutaneous portal of inoculation.

It will be apparent from even this partial review of the literature that the picture of primary inoculation tuberculosis of the skin (excluding tuberculosis verrucosa cutis) has been gradually taking form over a period of years and that a type with varying and sometimes slight degrees of local reaction, but important metastases to adjacent lymph nodes, is assuming distinct definition. In order the more clearly to delineate the type and to illustrate some of the diagnostic problems involved, my experience with 10 cases is summarized in the following condensed reports:

Case Reports. Three types were recognized in my series: inoculation on the face, illustrated by 5 cases; inoculation on the forearm or hand, illustrated by 3 cases; and inoculation on the foot, illustrated by 2 cases. Two patients have presented what

seems to have been a tuberculous lesion of the umbilicus, whose right to be called an inoculation focus is as yet undetermined. In contrast to the tenor of the literature, only 3 of my patients were young children, two, four and five years of age. Three were adolescents—thirteen, sixteen and seventeen years of age—and 4 were adults, all of them over thirty and 2 nearly or over forty years of age. There were 5 males and 5 females. Most of the patients were in the best of health at the time of infection, to all outward appearances, only one child being sickly following measles. The relatively benign character of the infection seemed apparent from the continued good health of the patients, the absence of signs of generalization of the infection and the good response of the majority once we had developed a technic of treatment. Complete studies were not made on the earliest case, in which I was frankly incorrect in my interpretation of the clinical picture. But taking the group as a whole the tuberculous nature of the condition was carefully checked by clinical and laboratory criteria, including animal inoculations, exclusion of syphilis and later by the important cultural and microscopical exclusions of sporotrichosis and actinomycosis respectively.

Case I.—A boy, aged two years, seen in 1917, presented a massive swelling with a number of discharging sinuses over the right preauricular and cervical regions (Fig. 1) and temperature of 101.4° F., the entire process being of five months' duration. The first involvement had appeared above the parotid gland and had progressed downward, with successive incisions for drainage. Above the right malar prominence was a small depressed scar-like lesion, about 1 cm. in diameter, about which a few apple-jelly nodules could be demonstrated by diascopic pressure. No information as to the origin or course of this lesion was obtainable. Tubercle bacilli were present in the caseous material and discharge from the glands. Tonsils and adenoids were enlarged, but except for slight bronchial thickening the lungs were clear. The child's general health had remained good. The mother's examination was incomplete, but it was noted that an x-ray examination of her chest

showed tuberculosis of both apices. Following tonsillectomy, adenoidectomy and partial excision of the cervical glands, with coincident administration of six intravenous injections of neo-arsphenamin for its non-specific effect, a rapid improvement followed. Ten months later the child was gaining steadily and an *x*-ray to the glands was advised.

FIG. 1.—Probable primary inoculation site on the right temple (Case I) with metastatic tuberculous glands.

Although I placed the "cart before the horse" in erroneous diagnosis in this case, regarding the lesion on the temple as auto-inoculative or metastatic, and have corrected myself in retrospect only, all the essentials for a presumptive diagnosis of primary inoculation tuberculosis, except the time sequence, are here presented. Attention should be particularly drawn to the primary lesion, a small scar-like depression whose peripheral spread is marked by the appearance of the so-called apple-jelly nodule in the faintly pink areola of slightly-inflamed tissue about the scar. A few such nodules persist in the scar itself.

The apple-jelly nodule, upon whose identification at the site of inoculation the clinical diagnosis will often depend, is a tubercle in the deeper layers of the corium or the fat, which is ordinarily invisible in the pink or red of the inflammatory base, but can be detected by expressing the blood from the tissue with a glass spatula, the lip of a tumbler or even a microscopical slide. When viewed thus through glass under pressure the brownish translucent miliary tubercle, 1 or 2 mm. in diameter, stands out clearly against the pale background. "Apple-jelly nodules," a term which their color suggests, are not absolutely characteristic of cutaneous tuberculosis, for coarse ones may be found in certain tuberous and nodose hypertrophic syphilids. But in general they are a helpful guide to diagnosis and often the first feature to arouse suspicion at a site of traumatic inoculation. The successive involvement of the parotid, cervical and submental glands suggests the usual course of a lymphatic metastasis from a cutaneous source.

Fig. 2.—Primary inoculation tuberculosis (upper lesion) with typical broken-down metastatic lymph nodes. Note the miliary tubercles in the margin of the tuberculous lesion and the depressed scar-like center.

Case II.—A girl, aged seventeen years, seen in 1917 (Fig. 2), complained of an ulcer on the left cheek of six months' duration. On examination this was found to be partially healed, forming a

plaque over the left zygoma whose center had epithelialized and whose periphery was marked by scattered apple-jelly tubercles. Just anterior to the right ear was a subcutaneous bluish infiltration and just below this the anterior auricular gland had broken down. The gland had been drained but no stain had been made for tubercle bacilli. While the patient was pale and the right apex showed slightly increased fremitus the general examination gave no evidence of systemic infection. Three hundred milligram hours of radium and a curettage of the gland failed to afford relief, and the primary lesion was later excised, according to a letter received from the patient, as epithelioma. The study of this case must be regarded as incomplete, but its clinical details accord with our subsequent observations.

Case III.—This was the first example of inoculation upon the foot in our series, and although primary lesion and metastasis were far apart and not visibly connected, it was possible satisfactorily to relate the two by clinical and laboratory evidence. A boy, aged five years, seen in 1919, had developed a mass in the inner aspect of the left thigh (Scarpa's triangle) following a fall from a tricycle. In order to indicate how completely the history of a case may mislead an examiner the following literal transcript is made: "This child has always been strong and robust. Two months ago he was supposed to have injured the inner side of the thigh riding a tricycle. After a few weeks a lump appeared at the point of injury, tender but not inflamed. It gradually enlarged. After applying a poultice for some time the lump softened and opened up with slight discharge. The child was now operated upon, a growth the size of a hen's egg being removed. Reported to be a lymphosarcoma. It has always been noted that scratches and abrasions heal slowly." No note was made of any other injury than the fall. A search for the primary lesion, following a report of inflammatory tissue in a biopsy from the ulcer in Scarpa's triangle, revealed the inoculation focus on the great toe. Thereupon further questioning of the mother recalled the fact that the boy had had a small infected lesion at this site which was

opened and drained two or three weeks before the trouble in the groin and subsequent to the fall from the tricycle. The primary tuberculous lesion thus identified consisted of a group of apple-jelly tubercles, with only the slightest surrounding inflammatory reaction, about a healed cut on the inner side of the left great toe. A biopsy, including several apple-jelly nodules, was then taken from the inoculation site and typical tubercles demonstrated histologically (Fig. 3). Radium to the toe and the glands resulted

Fig. 3.—Tissue from the primary inoculation site on the great toe (Case III). Note the typical tubercles deep in the cutis, which could be seen as apple-jelly nodules under glass-pressure.

in rapid healing and the boy was reported in good health six months later. The von Pirquet test was strongly positive at the time the diagnosis was made, but no other evidence of systemic tuberculosis was found.

Case IV.—This was the third instance of inoculation upon the face and presented several puzzling features. A boy, aged four years, had run a stick into his left tonsil ten months before exami-

nation (1920). Two or three days later the mother noticed a small lump under the skin of the sternocleidomastoid region. Coincidently a small pustule on the left cheek, about 5 cm. above the angle of the mouth, was noticed. The lump on the neck increased in size, softened, was opened, healed and broke down again three weeks after an attack of measles. Since the measles the child had been sickly, with occasional fever and vomiting, and had sustained what was regarded as an attack of unilateral "mumps," which apparently consisted of a marked rapid enlargement of the glands on the left side of the neck with profuse discharge from the sinus. There was no familial or contact history of tuberculosis. The focus on the left cheek consisted of a small superficial dry crateriform scar-like depression midway between the zygoma and the left labial commissure with typical apple-jelly nodules scattered about the immediate periphery of the lesion. Below the ramus of the left jaw was a sinus leading to an enlarged gland. There was little or no discharge and through oversight neither cultures nor stained smears were made. The von Pirquet test was negative and the chest, which at first showed some hilus infiltration, was reported negative three months later. No sulphur bodies could be found. The diagnosis of primary inoculation tuberculosis remained clinical therefore and the patient was treated with radium. Complete healing and no recurrence was reported a year later after 1040 mg. hours to the neck and 575 mg. hours to the lesion. In view of the negative von Pirquet test, which, however, was not repeated, and the incomplete laboratory study, this case may remain *sub judice*, although the morphology of the cutaneous lesion was typical of the series. The tonsillar injury gave the impression of coincidence rather than cause.

Case V.—This case, seen in 1921, was my first example of infection on the arm and occurred in a veterinary surgeon, aged thirty-nine years, who sought relief for a draining sinus from a softened gland in the right axilla. His attention had been attracted to it as much by the sense of tenseness and difficulty in extending the arm as by the discharge itself. There was no familial history of tuberculosis

or of human tuberculous contacts, but the patient was constantly exposed to bovine and avian infection in the course of his operative and postmortem work. The dermatological consultation had been called to consider the advisability of using arsphenamin in preference to surgical excision of the gland. Upon further examination a pipe-stem lymphangitis, indolent and non-inflammatory, was found to explain the discomfort on movement of the arm. The cause of the difficulty did not become visible until the arm was fully extended above the head (Fig. 4). On search for a primary focus I found upon the extensor surface of the fore-

FIG. 4.—Tuberculous lymphangitis of the upper brachial lymph channels leading to a softened axillary lymph node. The primary lesion is shown in Fig. 5. The lymphangitis could be recognized only on raising the arm, and was indolent and non-inflammatory (Case V). The same condition developed in Case IX.

arm a small discolored scar-like patch, the remains of a nodule that had appeared a year before, been cauterized with phenol and iodine and disappeared (Fig. 5). In the center of this scar, under glass-pressure (Fig. 6), a ring of about a dozen small apple-jelly tubercles, acting as the feeder focus for the lymphangitis and gland, was identified. The epitrochlear gland was only slightly enlarged. The excised axillary gland showed typical tuberculosis with caseation and the widely excised primary focus on the forearm also showed typical tubercles. A few acid-fast organisms were found in the skin sections. Inoculation of guinea-

FIG. 5.—Primary focus on the forearm, of one year's duration (Case V).

FIG. 6.—Effect of glass-pressure in bringing out the barely visible ring of tubercles (apple-jelly nodules) in the scar.

pigs was not successful, due to the death of the animals from secondary infection. Inoculation of hens and roosters was negative.

The treatment employed in this case summarized the results of my experience with the condition up to this time and consisted of excision of gland and primary lesion, the latter being removed to the fascia; one course of five injections of neoarsphenamin; 33,356 mg. hours of radium to the axilla (Dr. Bowing) and along the course of the involved lymphatics and the excision scar. A slight edema of the hand developed and disappeared without event. A year after diagnosis the patient developed an ischiorectal abscess which did not appear to be tuberculous and which healed promptly after simple drainage. At no time, either on first examination or subsequently, during a three-year period of observation, has there been any sign of systemic infection.

Case VI.—A boy, aged thirteen years, seen in 1921, was the clinical twin of Case III, seen in 1919. This previously healthy youth had developed a mass in the inguinal region which broke down and discharged three weeks after the healing of a cut on the outer aspect of the left great toe. In this case the connection with the injury was more easily traced than in Case III. The toe had been cut by a piece of tin while the patient was swimming and had healed without complications, but a mass the size of a hen's egg had developed in the groin just three weeks later. This had subsided of itself but had lately recurred. The scar on the toe had likewise shown signs of renewed activity and had opened and drained one month before the patient came to the clinic. A surgical diagnosis of glandular tuberculosis, confirmed by pathological examination and positive guinea-pig inoculation from the excised glands in Scarpa's triangle, was made on first appearance, but the primary lesion on the toe was overlooked. The result was a recurrence in the glands four months later, this time in the inguinal region, and dermatological consultation was then called to consider arsphenamin as adjunct treatment. The primary focus on the great toe (Figs. 7 and 8) was then found and the presence of apple-jelly tubercles demonstrated in the healed scar by glass-pressure and in the excised tissue following biopsy. Guinea-pig, rabbit and chicken inoculations from the toe tissue

were failures. This case, with other subsequent ones, furnishes an excellent example of the continued vicious activity of the "feeder focus" if its removal is not accomplished with the recog-

FIG. 7.—Note the scar at the site of the tuberculous glands in the left Scarpa's triangle, removed at operation (Case VI). Four months later, after a recurrence, the primary focus was discovered on the left great toe, as indicated by the pointer.

nition of the glandular metastasis. Microscopical examination of the skin from the focus showed the tubercles to extend much more deeply into the fat than the biopsy excision, so that an

almost complete dissection of the soft tissues of the ball of the toe was then necessary which delayed healing somewhat. Large doses of radium, two *x*-ray exposures and a course of eight injections of arsphenamin were employed, with apparently complete recovery during a two-year period of observation. The only ascertainable connection with a source of tuberculous infection in this case was a sister who had had Pott's disease, but who had been away from home for some time.

FIG. 8.—Tubercles in the border of the healed scar of a cut on the ball of the toe (Case VI). Metastasis occurred to the lymph nodes in Scarpa's triangle.

CASE VII.—This patient was diagnosed by Drs. McVicar and Flynn, of the medical division of the clinic, following the demonstration of Cases V and VI before the clinic staff. A woman of thirty-four, who had had a carcinoma of the cervix diagnosed and operated upon in 1920, returned in 1922 with a recurrence and inoperable metastases. In the course of her examination a chronic lymphangitis of the left arm was recognized. The presumptive primary inoculation site was found at the base of the fourth finger of the left hand on the palmar surface, at which point she had had a sore a year before accompanied by swollen axillary glands. The epitrochlear node had been involved and had been incised with prompt healing. Numerous apple-jelly nodules

were, however, demonstrable in the incision scar. The axillary glands had likewise enlarged and drained, but were now healing spontaneously. The scar of the primary inoculation site contained no tubercles demonstrable by glass-pressure, but a biopsy from the epitrochlear scar revealed many tubercles, some of them deep in the subcutaneous fat. The patient's condition was so serious as a result of her carcinoma that no further study or treatment was attempted. It is striking here, as in other cases of my own and in the literature, that the presence of tuberculous infection was no bar to the healing of the lesion, the reaction of the subcutaneous tissue being trivial while that of the lymphatic tissue was much more pronounced.

Case VIII.—A woman, aged thirty-eight years, seen in 1923, illustrates the years of activity during which a feeder focus may be responsible for a persistent glandular process and the relative ineffectiveness, of *x*-ray at least, in the treatment of such primary inoculation sites. The chief complaint was enlarged glands on the right side of the neck and beneath the chin of three years' duration. The onset was marked by the abrupt enlargement and softening of a single gland and subsequent involvement of others with successive incisions for drainage but without real improvement. A small reddened patch on the right cheek, present for five years and antedating the glands by two years, had been regarded as "lupus" and ignored until recently, when it had received *x*-ray treatment and a small amount of radium as epithelioma to the point of cutaneous reaction, with the production of atrophy and telangiectasia. The tonsils had been removed two years before the appearance of the glands. Pus from the glands was negative culturally and showed no tubercle bacilli on staining. Under glass-pressure the scar-like "lupus" patch presented little that could be called "apple-jelly nodules," so that I hesitated somewhat to advise its removal with the glands for diagnosis. I finally decided in favor of removal and was surprised to find that this supposedly "cured" focus contained, in spite of radiotherapy carried to the point of cutaneous reaction, large numbers of typical tubercles and giant

cells, apparently in full activity. The systemic examination of this patient revealed no other evidence of tuberculosis and no good history of contacts could be obtained. The patient did not remain for systemic treatment, but reported subsequently that glands had begun to appear under the other side of the chin. It is worth noting that this lesion (see also Case II) had been treated with *x*-ray as epithelioma and not as tuberculosis.

Case IX.—This patient, a physician in middle life, presented himself to me with the statement that he had made his own diagnosis on the basis of Case V in this series, which he had watched from the time the diagnosis was made. On examination he presented the same type of pipe-stem lymphangitis of the upper brachial lymphatic channel, visible only on extending the arm above the head (Fig. 4). The axillary gland had softened and in the draining pus numerous tubercle bacilli had been demonstrated. The primary inoculation focus had occurred on the extensor surface of the forearm apparently and had been furuncular in character. Healing had been complete, and though the scar was subsequently completely and deeply excised and serially sectioned I could find only the densest scar tissue and no tubercles. There was no systemic evidence of tuberculosis elsewhere. The gland was not excised but radium was liberally used and neoarsphenamin administered, with apparently good results. This sharp reaction, with complete scarring and destruction of all organisms at the inoculation site, though not verified by animal inoculation, is apparently what occurred in Case VII and is a theoretical possibility, as in the tuberculids, if the host is sufficiently reactive to destroy all organisms at the point of entry in a furuncular reaction, even though some of them escape to cause trouble higher up. Subsequent inoculation of an exposed healing "boil" seems less likely in view of the absence of tubercles in the scar.

Case X.—This patient presents some of the therapeutic problems of this form of tuberculosis of the skin. The inoculation lesion

developed on the cheek of a healthy young girl, aged sixteen years, who supposed that she had infected a pimple by scratching it. At the time of examination the lesion was an induration with an ulcerative surface and a few scattered puncta midway between the zygoma and the right labial commissure (Fig. 9). A small bluish nodule over the jaw and a gland beneath the ramus constituted the metastases. No history pointing to a source of infection could be obtained, though the patient lived on a farm. Sporotrichosis and extragenital syphilis were carefully eliminated and a biopsy showed the presence of tubercles in the lesion. The

FIG. 9.—Primary inoculation tuberculosis on the cheek of a young girl (Case X). There was a nodule over the ramus of the jaw, and a slightly enlarged node just below the ramus.

extensive induration (2 cm. diameter) with the metastases would, if treated surgically, involve a gross disfigurement of the face. It was accordingly decided to try the Kromayer lamp with pressure and to use ultraviolet light (Alpine Sun) and arsphenamin conjointly as systemic treatment. The response was gradual, but ultimately very satisfactory. The lesion healed completely (Fig. 10) under repeated severe reactions in the course of four months. The induration disappeared and the metastases subsided. My observation of the case terminated before the ultimate result could be determined.

Two cases have likewise come to my attention in which I do not as yet consider the diagnosis of inoculation tuberculosis proved, although laboratory evidence seems to suggest the tuberculous character of the initial lesion. Both the lesions developed at the margin of the umbilicus. In the one which I observed from the start, the patient's first complaint was of pain across the abdomen. An indolent furuncle-like lesion pointed at the upper margin of the umbilicus and discharged, leaving a draining sinus whose appearance suggested a tuberculous origin. Smears from the pus

FIG. 10.—Effect of four months' treatment of the lesion shown in Fig. 9, using the Kromayer lamp with pressure, general ultraviolet irradiation and neoarsphenamin intravenously. Diagnosis confirmed histologically, syphilis and sporotrichosis excluded.

showed acid-fast organisms. Guinea-pig inoculations resulted in what appeared to be tuberculous infections with involvements of glands and viscera. The general examination of the patient was entirely negative and no signs of a visceral focus could be found. A solitary gland appeared in the right axilla. There was no lymphangitis and the gland did not soften. Radium to the umbilicus and the axillary and inguinal glands, with neoarsphenamin and a general régime for tuberculosis resulted in a prompt disappearance of symptoms, which had in fact begun to disappear before the treatment was started. There has been no sign of relapse.

A second case has had a similar history, but a draining sinus persisted for several months after the initial lesion. There was some disagreement as to the tuberculous character of the acid-fast organisms found in the first case and the tuberculous character of the reactions in animals, so that these cases must be thought of as still *sub judice*.

The importance of differentiating lesions of this type from sporotrichosis will be apparent to all who are clinically familiar with the two conditions. Fig. 11 illustrates a sporotrichosis of the lip conforming in every particular to the clinical picture of

FIG. 11.—Sporotrichotic primary inoculation of the upper lip confirmed culturally and disappearing under iodide. Note the chain of metastases.

inoculation tuberculosis, except that typical apple-jelly nodules were not recognized (they need not invariably be present). The condition was culturally identified as sporotrichosis. The response of tuberculous and occasionally sporotrichotic lesions to arsphenamin treatment for syphilis makes this differentiation important and warns against therapeutic tests with this drug in the effort to reach a diagnosis of a doubtful lesion. This may be especially important in cases occurring about the genitalia, as noted by Holt and by Nixon and Short. The complete diagnosis of a primary inoculation tuberculosis should include the finding of apple-jelly

tubercles in the gross, the obtaining of smears containing tubercle bacilli, a negative culture for sporothrix, absence of actinomyces in the pus, positive guinea-pig inoculations of pus and tissue from both primary and secondaries and the demonstration of tubercles in excised tissue from the focus and the glands. In practice it is difficult to make this chain of evidence complete, but the finding of a focus and presumptive metastases in the lymphatic drainage area, with apple-jelly nodules in the primary and the histological demonstration of tubercles in excised tissue from both primary and secondary lesions, in the absence of other systemic forms of tuberculosis, make the diagnosis of primary inoculation tuberculosis reasonably sound.

SUMMARY. The literature is summarized and 10 cases described of inoculation tuberculosis of the skin with metastasis to lymph nodes. These cases are equally distributed between the two sexes and between childhood, adolescence and adult life. They suggest that reaction to tuberculous infection and its sequelæ varies with the individual and with circumstances rather than entirely with the fact of previous infection and acquired resistance.

The lesions described as primary are often inconspicuous, may be far from the site of lymphatic metastasis and are often in old traumatic scars. A history of exposure to tuberculosis may not be obtainable. The apple-jelly nodule, or tubercle in the cutis and subcutaneous fat, is the elementary essential lesion. Its identification by diascopic pressure is the first-aid to a diagnosis.

The glandular metastases may be confused with lymphosarcoma and simple inflammatory bubo, the primary lesion with syphilitic chancre, sporotrichosis, actinomycosis and epithelioma.

A painless and indolent lymphangitis may be the only symptom attracting attention in cases primary upon the arm, and this may only become visible on extension of the arm to the fullest above the head.

A delayed adenopathy developing after even trifling trauma should lead to examination of the lymphatic drainage area for a tuberculous inoculation focus.

A primary focus may serve throughout a period of months or

years as a feeder to a lymphatic metastasis and be responsible for repeated recurrence of glands in spite of drainage, curettage and excision. Scrofulodermatous ulceration of the skin may result at the site of the metastasis.

X-ray carried to the point of reaction may not destroy the primary focus or retard its feeder activities.

Excision of the primary focus, even if it is only a scar, and of its secondary glands is necessary to the best treatment and should be carried out wherever possible.

In dealing with the focus it is usual for the tubercles to extend much deeper than is anticipated, and excision should therefore be carried to the fascia and widely marginated.

Radium controls the lymphatic metastasis and is preferable to *x*-ray, in my experience, after excision in the treatment of the excision scars and drainage areas. Large doses, properly screened, should be used, but not carried to excess.

Ultraviolet light from the quartz lamp can be used locally with pressure in lesions that cannot be excised, and should be employed systemically in the form of general irradiation and artificial heliotherapy.

Moderate doses of neoarsphenamin, which contribute to a good result in tuberculids and some cases of glandular tuberculosis, may be used in the treatment of primary inoculation tuberculosis as part of the general management of the case.

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DISCUSSION

Dr. Eugene L. Opie: This communication of Dr. Stokes gives those interested in tuberculosis a great deal to think about. It is often difficult to correlate the pathology of human tuberculosis with experimental observation. If tubercle bacilli are injected into a fresh guinea-pig a local lesion occurs, the nearest lymph nodes are soon infected and there is finally general dissemination of the disease. If, however, tubercle bacilli are injected into an animal already infected, as Koch found, there is a local lesion which is at first more active than that of the fresh animal but after a time undergoes healing; the lymph nodes are not involved. Tuberculosis in children has the characters of tuberculosis in the uninfected animal, but the pulmonary tuberculosis of adults has very little resemblance to tuberculosis of the fresh animal. In the adult there is a local lesion at the apex of the lung which is chronic and fibroid and the nearest lymph nodes are not infected, whereas in the child a pulmonary lesion is accompanied by tuberculosis of the lymph nodes which soon becomes far more conspicuous than the focus in the lung. By the time adult life is reached almost everyone has been infected at least once with pulmonary tuberculosis and the evidence of this infection remains in the body, so that apical tuberculosis is a second infection and is not followed by tuberculosis of the lymph nodes. The inoculation tuberculosis

of the skin with infection of the adjacent lymph nodes which Dr. Stokes has seen in children acts exactly like tuberculosis of the child's lungs. The inoculation tuberculosis of adults with which we have heretofore been familiar, namely, the tuberculous warts which occur on hands of pathologists who have performed autopsies on tuberculous individuals, and the similar warts which occur on the hands of veterinarians, butchers or others who come in contact with tuberculosis of cattle, are rarely followed by dissemination to lymph nodes or other organs. The most obvious explanation is that they occur in adults who have previously undergone the almost universal tuberculous infection of children. Dr. Stokes' cases in which inoculation of adults has been followed by tuberculous lymphadenitis are not so readily explained. It is difficult to escape the conclusion that some of these adults have been previously infected with tuberculosis for few individuals escape the latent infection of childhood. Instances of progressive tuberculous lymph adenitis in adults proceeding from bronchial or other lymph nodes are occasionally seen. The disease in these instances has not the acutely progressive character of tuberculosis in the previously uninfected child. It is probable that under certain conditions progressive tuberculosis of lymph nodes may occur even though the patient has had the usual latent tuberculous infection of childhood.

Dr. Hobart A. Hare: I would like to ask Dr. Stokes if his use of arsphenamine in tuberculosis showed any definite indication of specificity of arsenic compounds for parasites of the vegetable kingdom? There have been several papers published by enthusiasts as to the use of arsphenamine in which the patient got well of a bacterial infection in spite of the use of arsphenamine. I would ask whether he was trying various things and found arsphenamine successful, or whether there was some scientific lead which led him to employ it for bacillary rather than protozoal infection.

Dr. Stokes (closing): The only point which I can add to my remarks is in answer to the question regarding the use of arsphenamine in tuberculous conditions. I was led to undertake the treatment of so-called tuberculids by the observations of Nicolas, Courmont, Gaté, and Charlet, who before the war succeeded in demonstrating an increase in the agglutinins for tubercle bacilli in the blood of tuberculous patients following the administration of arsphenamine. It was found that if the tuberculous patient was on the up-grade or presented a high resistance to the disease, he often showed a marked clinical improvement, whereas if he were on the down-grade, he showed no improvement or was made worse. Ravaut. Tzank, and Pelbois used arsphenamine clinically in the treatment of tuberculids with some observed good results. My own experience has

now covered a period of some years, and I am satisfied that arsphenamine exerts a non-specific action on tuberculous processes, especially of glandular origin. The effect is not at all directly parasiticidal in the sense that arsphenamine is spirillicidal. Apparently the results are accomplished by raising the general resistance of the patient towards the tuberculous infection. The response in tuberculids is sometimes almost as striking as in some syphilids and gives rise to important possibilities of error in diagnosis. As you well know, arsphenamine has to its credit many useful non-specific therapeutic effects, among them being included in my own experience effects on inflammatory processes in the eye which do not appear to be either arsenical in character as such nor directly parasiticidal.

APPENDIX

PROCEEDINGS

OF THE

SECTION ON OPHTHALMOLOGY

JANUARY, 1924, TO DECEMBER, 1924

JANUARY 17

Concerning Some Vascular Anomalies at the Base of the Brain in Their Relation to Visual Field Defects. Illustrated

Dr. George E. de Schweinitz discussed the regional anatomy of the pituitary body region and some vascular anomalies at the base of the brain which might be responsible for certain visual field defects. Lantern slides of colored drawings by Mrs. Chase, of dissections made by Dr. J. Parsons Schaeffer in the Daniel Baugh Institute of Anatomy of the Jefferson Medical College, in illustration of the remarks, were exhibited. These illustrations had previously been utilized in the Bowman Lecture of 1923.

Dr. Schaeffer said that Dr. de Schweinitz had covered the variations of the relational anatomy of the visual pathway and the hypophysis cerebri so well that he had little to add. Dr. de Schweinitz's presentation of the subject in general and of the lantern slides of the anatomy, based upon actual observations, must

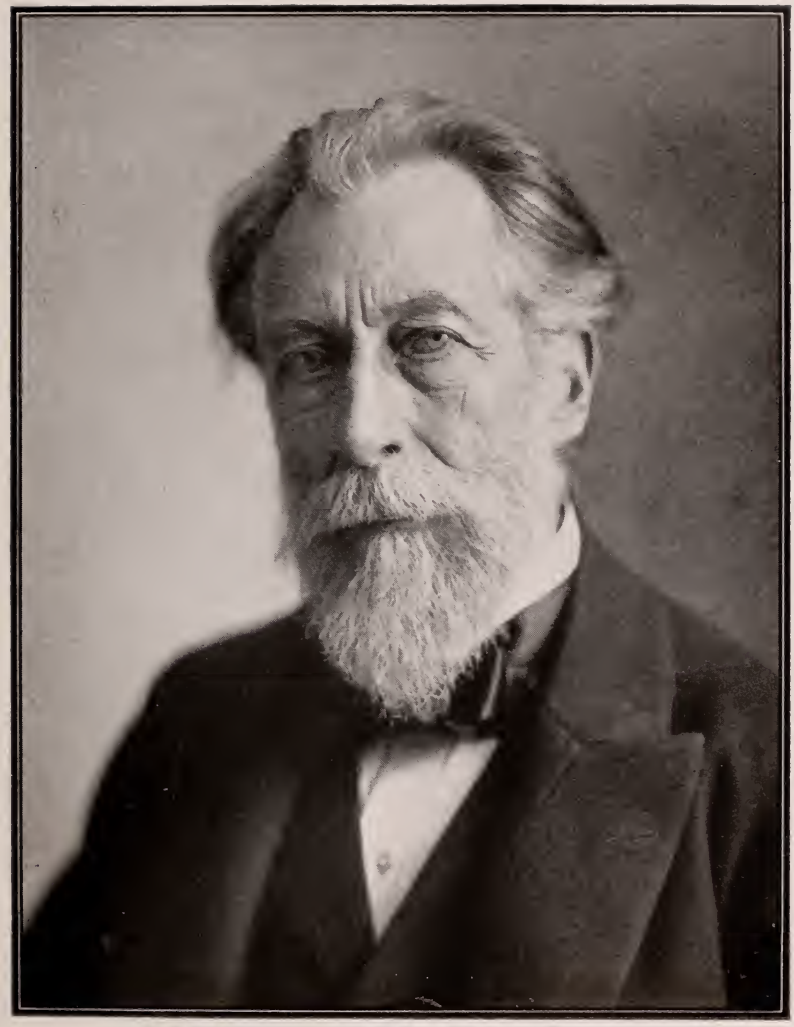
have impressed all of us assembled. Whether these morphologic variations at the base of the brain and skull underlie some of the eye manifestations in hypophysial tumors is difficult to say. However, the anatomic points seem significant and appear to be in consonance with certain clinical findings.

He emphasized the fact that we hold too much to an ideal and conventional anatomy. The patient in his anatomy is expected to conform to what has been handed down as the ideal. Yet, strictly speaking, there is no ideal. We have fallen into this error partly because we follow too closely, both in studying and teaching, the elementary and general treatises on anatomy, in which the best that can be accomplished is the presentation of a more or less fixed anatomy—the anatomy of an ideal body. Of course, students of medicine and physicians in the study of a patient must needs begin from the point of view of an average or conventional anatomy. However, in practice this has very definite limitations. Extensive study of regional anatomy based upon hundreds of bodies clearly points that anatomic variations preclude the possibility of an absolute constancy in clinical findings. He felt that in many obscure manifestations the solution may be found in the anatomic or morphologic type or variant.

Memoir of Dr. William Wallace McClure

Dr. S. Lewis Ziegler read the following memoir of Dr. W. W. McClure:

The death of Dr. William Wallace McClure, March 18, 1923, has robbed American ophthalmology of a distinguished practitioner who was one of the pioneers in this distinctive field of medicine. Born in Philadelphia September 3, 1842, the son of John McClure and Anna McCullen, his fourscore years brought him a life of rich experience and well-trained service to humanity. His preliminary education was acquired in the school at Andalusia and his medical training was received at the Jefferson Medical College, where he was graduated in 1864. He was appointed interne to the Philadelphia General Hospital, then called "Blockley,"



WILLIAM WALLACE McCLURE, M.D.

where he served for one year. About the close of the Civil War he was attached to the U. S. Hospital, "The Satterlee," which was located in West Philadelphia.

He began to specialize in ophthalmology on April 2, 1866, when he was elected a resident physician to the Wills Eye Hospital for the term of one year, serving under a staff of distinguished surgeons composed of Drs. George Morton, A. Douglas Hall, Richard J. Levis and D. Hayes Agnew. During the year following this service he went abroad to visit the European clinics, where he spent some time under the "master ophthalmologists" of that day. His keen powers of observation served him well during this visit, and because of the excellence of his home training, he quickly skimmed the cream from the foreign clinics. He was particularly impressed with the work done in Strycker's laboratory in Vienna, with the wonderful surgical insight of von Graefe, and with the wealth of material available for study in the continental clinics, bringing back with him a well-filled volume of colored sketches of the work he had observed in Europe.

On his return to Philadelphia he was elected, January 1, 1868, an assistant surgeon to the Wills Eye Hospital, on the service of Dr. Harlan, and in 1872 he was elected ophthalmic surgeon to the Presbyterian Hospital, which he served with fidelity and distinction until his retirement in 1886, when he was made consulting ophthalmic surgeon.

When the surgical staff of the Wills Eye Hospital was reorganized, in January, 1872, Dr. McClure was elected an attending surgeon, along with Drs. Dyer, Goodman, Keyser, Norris and Thomson. Drs. Harlan and Morton were the only holdovers from the old staff, while Drs. Hall and Levis, who had tendered their resignations, were reëlected in July of that year, after a six months' "moratorium." In 1873 Dr. Dyer resigned and Dr. Strawbridge was elected to fill his place. In 1874 Drs. Morton and Levis resigned, but their positions were not filled. In 1877 Dr. Thomson resigned and Dr. Schell was awarded the vacancy. This staff of eight surgeons continued intact until the retirement of Dr. Strawbridge and the death of Dr. Schell in 1890.

Dr. McClure's early ambition stimulated him to inaugurate a course of lectures on the eye at the Wills Eye Hospital that became very popular with the medical profession of Philadelphia, who crowded the front clinic room of the old hospital to listen to them. He discussed the human eye in its minutest details and also presented studies in comparative anatomy, especially portraying the fundus appearance of birds and fishes through stereoscopic slides. Among other things he exhibited a stereoscopic diagram of his new plastic operation for ptosis, which clearly antedates (1867) the one we know as the Hunt-Tansley operation, although the details are slightly different. For these lectures he stained and mounted many beautiful microscopic sections of the retina and other ocular tissues which were far above the average of that day and generation. He likewise prepared some beautiful models of the eye and of its musculature, which Dr. Norris considered so fine that he frequently borrowed them for use in his annual demonstrations before the senior medical class of the University of Pennsylvania.

The great success of his course of lectures engendered envy in some of his colleagues, which ultimately resulted in a rule being passed by the Board of City Trusts, in 1877, placing a partial embargo on teaching in the hospital. From the effects of this rebuff he never quite recovered. He was a gentle genius, of brilliant mentality, but after this period he became reserved, almost secretive, in working out the newer problems in ophthalmology; but to those whom he knew intimately, and reposed confidence in, he expanded like the sensitive plant, and then one wondered why he did not publish the novel and interesting results that he had obtained. He never published his course of lectures, and, so far as the writer knows, never publicly recorded any of his other works.

On his return from Europe he made many interesting and original studies of the ocular fundus and demonstrated the use of the Helmholtz ophthalmoscope to his colleagues. He was likewise one of the earliest to work out the intricate problems of astigmatic refraction, and succeeded in solving the high compound

hyperopic astigmatism of his friend and colleague, Dr. William Thomson, whose attention was thereby attracted toward ophthalmology as a specialty. The formula for this early refraction was as follows:

O. D. Sph. + 6.25D. ⌣ cyl. + 1.D. ax. 45 degrees.

O. S. Sph. + 6.75D. ⌣ cyl. + 1.50D. ax. 75 degrees

One can easily note the unusual character of this refractive error for that early day, since the plus spherical is extremely high and the cylinder axis is not according to the rule. When, in later years, Dr. McClure was offered the chair of ophthalmology at the Jefferson Medical College, he declined it because of his natural modesty and acquired distaste for teaching, and recommended that Dr. Thomson be elected to that position, which action was taken.

It is said that in these early days he would mark out the axis of the cylinder on paper, fasten his trial lens to it, place all in a tray, and carry it down to the shop of Mr. J. L. Borsch for grinding. In discussing the problem, one day, he and Mr. Borsch concluded that a protractor placed on the trial frame would obviate this, so that this protractor was added to the front of the frame. This was the first successful trial frame made in Philadelphia. There is no record of the exact year when this was done, but Dr. Louis Borsch, of Paris, recently confirmed the fact that he had often heard his father relate this tale about Dr. McClure. He also stated that Dr. McClure was one of the earliest to refract cases of mixed astigmatism with crossed cylinders, and that Mr. Borsch helped to work out the corresponding formula for grinding the equivalent spherocylindrical lenses.

Dr. McClure also deserves credit for the early addition of fractional numbers to the trial case in the strengths below 2 diopters, which he made up in 8th diopters to 1 D. and in $\frac{1}{4}$ diopters to 2 D. At first, however, these lenses were in English inches. It was not until the advent of the French Nachet trial case that diopters were accepted in America. I have seen this early case of trial lenses. It was weird but workable, being made up of a variety of lenses in style and size, in order to fill out the sequence. At a

later date he discarded this old case for one of the trial cases made up for the writer by Ivan Fox, having wide metal cells. Dr. McClure, in this early period, was *par excellence* the best practical refractionist in Philadelphia. While his hospital records were brevity personified, his private histories of refractive cases were the most voluminous and complete that I have ever seen, often covering more than a page of his record book. Instead of ordering full correction, he made proper allowance for the accommodation, and so made his patients comfortable.

The McClure iris-scissors were invented by him in 1868, according to a statement recorded by him in a personal letter to the writer. They were first made by Mr. J. H. Gemrig, and have been in continuous use at the Wills Eye Hospital for more than a half-century. They have been marketed in Europe under the name of Dowel (Luer), McDougall (Weiss), and other wrong appellations, although no such surgeons ever existed. They possess delicate "balloon springs," which interlock at the tips, and when correctly made and properly sharpened are undoubtedly the best and most satisfactory iris-scissors in existence today.

The writer, while serving as resident physician to the Wills Eye Hospital, 1887–1889, enjoyed Dr. McClure's confidence in working out many surgical problems with him. Dr. McClure always came to the clinic early or remained late, so as to avoid contact with any critical eye while operating. He was a beautiful operator. His cataract incisions, iridectomies and incisions for the anterior sclerotomy of De Wecker were equal to those of his colleagues, and often superior. His cases always recovered with a minimum of postoperative inflammation.

He was also a skilled therapeutist. His colleagues often commented with praise on the excellent results obtained from simple therapeutic suggestions made by him in consultation. Many jokes were passed about Dr. McClure's "Mixture," which some called his "paint mixture," composed of quinine and turpentine; but his results from the use of this mixture in iritis, chronic iridochoroiditis, rheumatic sclerotitis and other inflammations of this type were most convincing and fully justified its use. His wet

compresses of quinine-muriate exerted an undoubted bactericidal control.

His knowledge of the collateral sciences enabled him to work out many interesting problems and made him an expert and connoisseur in various fields. During the World War he devoted all his energies to the working out of a new and ingenious test for colored vision, based on an entirely original theory, but it is not known whether he was able to complete this test or not. He had planned to present the result of these labors to the U. S. Government. He was a member of the Pathological Society of Philadelphia, the Historical Society of Pennsylvania and other learned societies, but in later years he resigned from most of them.

He was a well-known collector of curios and oriental rugs. These became his hobby. His valuable collection was mounted on the walls of his home and contained many fine examples of early Indian articles, Egyptian relics, Chinese curios, oil paintings and other rare and interesting works of art. His choice rugs from the Orient were always objects of admiration to experts.

His chief amusement was free indulgence in the sport of Izaak Walton. His periodical camping trips were greatly enjoyed by those who were fortunate enough to be his companions. Whoever participated with him in one of these hunting expeditions always wondered at the thorough preparation he had made, the complete and compact outfit that he carried and the unusual knowledge of woodcraft and piscatorial lore that he displayed. His ability as an expert rifle-shot was well known.

Dr. McClure was married and had one son, Dr. Sorden McClure, who graduated from the University of Pennsylvania and was later associated with him on his Wills Hospital clinic. The unexpected death of this son from a retropharyngeal abscess, that suddenly ruptured and drowned him by entering the lungs, overwhelmed both parents with sorrow and caused Dr. McClure to gradually relinquish all of his work. He retired from the Wills Eye Hospital December 9, 1907, after an uninterrupted service of more than forty years, and was made Emeritus Surgeon. He succumbed to cerebral hemorrhage. His widow alone survives him.

Sarcoma of the Choroid

Dr. Howard F. Hansell reported, briefly, 5 cases. The principal points of interest are the diagnosis, the tension and the metastasis. The first is in most cases not difficult, although it is not always possible to prophesy the character of the growth. The patient complained only of partial loss of vision. He suffers no pain and, curiously, has no photopsia; the eye is not congested, and externally its appearance is unchanged. The detached retina, fixed over most of its extent; its different levels, the absence of waving, the shadow cast by the transilluminator and the gradually increasing loss of the visual field are cardinal diagnostic signs. Tension is not increased by the tumor *per se*. When the lens has been pushed forward and the filtration angle closed by iris tissue the glaucoma stage has been reached and pain and high tension become prominent symptoms. Metastasis by the lymphatics and by the bloodvessels from other organs to the eye, from the eye to the lungs and liver, and from one eye to the other, is recorded. In Dr. Hansell's experience metastasis from the eye is rare, and he believed that its danger has been exaggerated. Early enucleation is advisable.

Dr. de Schweinitz expressed the opinion that the diagnosis of detachment of the retina due to a tumor, although often presenting apparently characteristic features, was not, in certain instances, free from difficulties. He detailed briefly the case history of 2 cases in which, although the appearances were definitely those usually ascribed to a growth, after enucleation it was found in the one instance that the elevation of the retina had been caused by an exudation, and not a morbid growth, and in the other by an exudation composed of round cells not sarcomatous, but probably due to a chronic inflammatory process. He called attention to Sir William Lister's statement that if there was a "hole or rent in the retina" it was most unlikely that it covered a morbid growth, that is, a sarcoma. He agreed with Dr. Hansell that the stage at which enucleation of an eye containing a sarcoma is performed does not certainly influence the occurrence of metas-

tasis. He referred to von Hippel's recent research, which indicated that metastases were not more frequent after operation in the second stage than after those performed during the first stage. Nevertheless, for obvious reasons, early enucleation should be performed.

Dr. S. Lewis Ziegler said, in regard to the question of remote metastases, he wished to call attention to the case of the late Dr. Strawbridge, who retired from the Wills Eye Hospital in 1890, because of supposed melanosarcoma of the choroid, for which enucleation was performed. A microscopic examination by Dr. Herman Knapp revealed a fibrous character that led to a favorable prognosis of non-malignancy. This prognosis proved to be correct, as he lived comfortably for a quarter of a century, but he finally succumbed, in 1914, to a recurrence that involved the liver and showed metastases in other portions of the body.

Dr. J. B. Turner referred briefly to a case upon which an iridectomy for glaucoma had been performed. Following this operation the wound failed to heal and a few months later the lens protruded. Later, Dr. Turner enucleated the eye. Microscopic examination revealed an unsuspected sarcoma of the choroid. Metastasis of the liver was noted eight years later.

Dr. Holloway referred to a patient he had seen in consultation, who had a moderately large intraocular sarcoma situated well forward on the nasal side of the globe. While, with the pupil fully dilated, the anterior face of the growth could be noted by careful oblique illumination, studies made with the corneal microscope and slit-lamp illumination proved to be very interesting. One could readily note the numerous aneurysmal-like dilatations of the vessels coursing over its surface, and in addition to this could readily see the formed elements of the blood coursing through the vessels. It afforded an instance of the intraocular visible streaming in a way long to be remembered.

Cases of Focal Infection

Dr. Mary Buchanan reported 4 cases of focal infection, 3 of which were due to the teeth and 1 to the tonsils.

The first case—a dentist—complained of distortion of objects, difficulty in reading, and vision, right eye, 5/15. The ophthalmoscope revealed a slight hemorrhage and a number of small spots of choroiditis in the macular region. Examination showed a forgotten packing in a bad molar, upper right side, and pus in the right antrum. Under appropriate treatment vision was improved to 5/18.

The second case—a woman, aged sixty years—suffered from spots in front of the right eye. There were numerous discreet retinal hemorrhages and vision = 5/15, corrected to 5/12. Left eye: negative. *X*-ray of teeth showed four upper molars and three lower central incisors infected; these were extracted and an autogenous vaccine given. The hemorrhages rapidly absorbed and vision improved to 5/4.

The third case—a man, aged forty-two years—a shopman, had vision of counting fingers at one foot. History showed that following exposure to oxyacetylene welding the eye had developed an iridocyclitis, with pupil contracted and occluded. An abscess of the left upper first bicuspid was noted by *x*-ray. Following extraction, considerable pus was discharged during the night. Local treatment, combined with mercurial inunctions and serobacterin injections, proved efficacious, and vision rapidly improved to 5/5.

The fourth case—a woman, aged fifty-years—had periodic blurring of vision in the left eye, associated with epiphora. The fields showed an enlarged blind spot, with the green field greatly limited. There was septum deviation, with bulging of the ethmoid. Submucous resection with evisceration of the ethmoid brought about an improvement of vision to 5/6. Later, following an attack of tonsillitis, the patient complained of hazy vision. Fundus examination showed retinal hemorrhages and vitreous opacities. Vision = 5/5 partly. Nine months later the patient developed several patches of choroiditis above and below the disc, with reduction of vision to 1/22. Following tonsillotomy, hemorrhages gradually disappeared and vision restored to 5/4½.

Vascular Anomaly of the Retina. Chronic Conjunctivitis of Unknown Origin

Dr. Hunter W. Scarlett reported a woman, aged twenty-six years, complaining of headaches. Right eye = 20/70. Left eye = 20/30. According to the patient vision commenced to fail while she was pregnant, about one and half years ago.

External examination negative, except for slight enophthalmos of the right eye.

Fundus examination showed the disc poorly defined and a tremendously enlarged vein, about twice that of the normal, coming off the inferotemporal side of the disc and pursuing a tortuous course toward the lower periphery, where it ended in, or under, a large, somewhat conical-shaped red mass. The corresponding artery was notched for a short distance after leaving the disc, and it, too, disappeared in the above-mentioned red mass. The other veins were also somewhat enlarged.

To the temporal side of this red mass was a large detachment of the retina, which extended up the periphery to nearly the horizontal meridian. Numerous grayish-white areas were seen to the nasal side of the fundus, which were reticulated in places and streaked in others.

Right eye with correction = 20/20. Left eye with correction = 20/15.

Dr. Scarlett also reported a man, aged thirty-one years, who consulted him because of a growth on the palpebral conjunctiva of the right upper lid. Condition had existed, to his knowledge, for about three years. Itching and burning of the eye were present, worse in warm weather and in tropical climates.

Examination revealed a grayish-white, spongy growth covering the inner third of the tarsus and part of the cul-de-sac. It was only slightly elevated. There were two discreet areas, about 2 mm. in diameter, one in the middle and one toward the outer angle of the lid. The lesion was not ulcerated.

Smears, cultures and section of a piece of tissue were all negative for fungus, spirochetes or any form of protozoa. Inoculation

into guinea-pig negative for tuberculosis. Inoculation into the anterior chamber of the rabbit negative for any growth. The only pathology present in sections of the tissue was chronic inflammatory tissue and large numbers of eosinophiles.

FEBRUARY 21

Congenital Papilloma of the Eyelids

Dr. Mary Buchanan presented the case of an infant, aged six weeks, with a tumor like a soft mole, protruding from between the lids, attached to the skin at the outer canthus of the right eye. It was about 0.5 cm. in diameter and covered with skin. Except at the canthus it was free from the lids and attached by a long pedicle extending upward to above the tarsal plate. Whether it extended into the orbit was a question it was impossible to decide without some surgical procedure.

Dr. Luther C. Peter suggested that the best method of procedure would be to give the child chloroform, in order to make as thorough a study as possible of the extent of the cyst. If it is attached to the lid only, it could be removed without difficulty; if it extended well back into the orbit, as in many cysts of this character, the operation might be too formidable to undertake at this early age, and could be safely postponed until the child was about six months of age.

Dr. William Zentmayer said that he had not seen previously a case in which so much of the dermoid was extraorbital. He presumed the pedunculated appearance was due to constriction by pressure on the lids at the external commissure.

Operative Results in Cicatricial Ectropion. A Case of Traumatic Enophthalmos. Traumatic Detachment of the Choroid

Dr. William Zentmayer presented a colored man, aged thirty years, who came to the Wills Eye Hospital because of a cicatricial

ectropion due to a wound which extended from the check through the lid into the floor of the orbit. The eye had been removed because of the injury. It was impossible to insert an artificial eye. An effort was made to correct the ectropion, feeling that this alone would accomplish the desired end.

There was a bridle of conjunctiva stretched across a shallow cul-de-sac at the site of the wound. This was treated by Berens' procedure, with some improvement. The operation for the ectropion was practically one that was devised by Imre for the correction of similar conditions resulting from war injuries. The upper part of the scar was excised by four incisions, which left a diamond-shaped wound. From the horizontal angles of this diamond, incisions were made laterally to the margin of the lid as far as both canthi. By uniting the raw edges of the two flaps the lower lid was reconstructed. The skin below and to the outer side of the diamond was freely undermined, and this flap was drawn over and united to the other side of the diamond. In excising the scar the wound was carried into the orbit and a suture inserted to close the incision. The result was satisfactory: the patient easily wears an artificial eye and the line of the lid is perfect.

A Case of Traumatic Enophthalmos

Dr. Zentmayer said that the patient, a farmer, aged thirty-five years, on December 21, 1923, while assisting in an operation on a calf, was kicked in the right eye. He was seen about an hour after the accident. The lower lid was torn from the inner angle just mesial to the punctum, along the inferior orbital margin, about two-thirds of its length. The cartilage in the upper lid was ruptured vertically to the inner side of the middle of the lid. The skin wound was about 3 mm. long, and there was a subconjunctival hemorrhage. About ten stitches were inserted. The next day the patient complained of diplopia, and about a week later examination showed paresis of the inferior oblique and the four recti muscles.

February 13 it was noticed that there was a contraction of the

frontalis on the right side, with marked arching of the brow and an enophthalmos of about 4 mm. Confidence in the diagnosis of fracture of the orbit led to postponing an *x*-ray of the orbit until February 17. Dr. Henry B. Pancoast reported no evidence of fracture, but said that he feared the *x*-ray was made at too long an interval after the injury to show a linear fracture which might have been detected at the time of the accident.

The case is of value for its bearing upon the pathogenesis of enophthalmos. There seems to be no other way to explain the involvement of the third and sixth nerves than by a fracture through the sphenoid fissure, although this in no way invalidates such a theory as has been advanced by Dr. Shoemaker to explain this symptom.

Traumatic Detachment of the Choroid

Dr. Zentmayer also exhibited an ironworker, aged thirty-seven years, who, on January 18, 1924, was struck in the right eye by a drift pin. Examination five hours later showed a large iridodialysis, extending from 11 to 9 o'clock; pupil partly dilated; hyphemia; lens *in situ;* form field apparently full; vision, 1/60. Three days later there was marked ciliary injection, pupil straight-edged, up and out, and apparently a choroidal detachment over the nasal portion of the fundus well forward and extending upward to about the equator, probably due to a subchoroidal hemorrhage. Field contracted above and on the nasal side. Vision with correction, 20/70. The eye-ball was soft. There was an enophthalmos of about 2 mm., and the disc was pale, with the upper inner border slightly prominent. Over the area in which the choroid was detached there was marked sclerosis of the choroidal vessels, with considerable intravascular pigmentation and haze of the overlying retina. This disturbance reached from just anterior to the equator almost to the border of the disc. At the macula there was a more superficial disturbance in the choroid. The field taken recently shows marked concentric contraction.

The two particularly interesting features are the detachment

of the choroid and the marked variations in the refraction: January 21, sph. — 2. ⌒ cyl. — 1 ax. 90 deg. = 20/20; January 30, sph. + 1. ⌒ cyl. + 2.50 ax. 95 deg. = 5/20; February 5, sph. + 0.25 ⌒ — 1 ax. 30 deg. = 20/40 pt.; February 8, cyl. + 1. ax. 105 deg. = 20/30 pt.; February 21, sph. — 0.50 ⌒ cyl. — 0.75 ax. 30 deg. = 15/30.

The eye was under atropin up until February 8. It is evident that there was paresis of accommodation, as, with a sphere + 4, with the correction glass the near-point was 20 cm. Other interesting features are, of course, the iridodialysis and the beginning enophthalmos. As yet the patient is not neurasthenic and seems to assist in every way in the tests. He, however, complains of not seeing well to the outer side of the affected eye.

Dr. Adler inquired if the change in the correcting glass accepted from time to time was due to the actual changes in the dioptric properties of the eye or whether the patient was allowed to choose the glass; also, if retinoscopic examination has been made and the changes verified as being due to actual changes in the refraction?

In reply, Dr. Zentmayer said that the refraction tests had been made subjectively, and he supposed the variations to be due to changes which occurred in the level of the retina, with alterations in the subchoroidal exudate and to variations in the action of the ciliary muscle, which appeared to be but partially paralyzed.

A Case of von Hippel's Disease

Dr. J. Milton Griscom reported the case of a man, aged twenty-six years, whose medical history and present physical examination were negative in all respects. His right eye had been blind since early childhood, and subsequent enucleation confirmed the clinical diagnosis of chronic choroiditis, made at the time of his admission to the Wills Eye Hospital.

In the left eye the vision was 1/20, corrected to 1/10. The anterior segment, the lens and vitreous were normal. The region of the disc was covered by a band of grayish exudate, which began about

4 d. from the disc up and in and ran an equal distance to the temporal side and somewhat downward. In this exudate were dilated vessels and others small and degenerated. The lower half of the fundus was occupied by a large detachment of the retina, together with enormously dilated arteries and irregular patches of exudate, which became more dense in the periphery. On the temporal side was a flat, irregular area of exudate, with several small spots of hemorrhage near its border. In the upper part of the fundus, projecting into the vitreous about 3 diopters, was a cone-shaped, whitish mass ½ d.d. in diameter, capped with a reddish nodule. The vessels which ran into the base of this cone were somewhat enlarged, but the remaining vessels in the upper one-third of the fundus were small. The case was considered one of true angiomatosis of the retina of the type first clearly described by von Hippel.

Dr. Posey said he considered the case one of von Hippel's disease, the diagnosis being made by the distended appearance of the vessels, the retinal detachment and the characteristic vascular dilatations.

A Case of Rupture of Iris Associated with Neuroretinitis

Dr. Frederick Krauss presented a case of neuroretinitis, with rupture of the iris, in a boy, aged fifteen years, caused by a large birdshot striking the left eye near the corneoscleral junction on the temporal side. There was no penetration, but a small hyphemia. Fundus examination showed disc edges hazy with some fulness of the veins; no hemorrhages. The *x*-ray was negative. After the absorption of the hyphemia a long rupture of the iris near the ciliary border was seen, the edges of the torn iris irregular in outline and the root of the iris plainly seen. The pupil remained dilated with a straight edge on the side of the rupture. The lens showed a crescentic-shaped area, extending from above downward, consisting of fine pin-point opacities similar to those seen in the well-known Vossius ring.

One week later the optic nerve head was swollen about 4 D.

with edema extending into the retina. The veins were enormously engorged with hemorrhages on the nasal side below. This swelling has been gradually disappearing and vision improved from 5/30 to 5/10, with nearly full visual field.

Dr. Posey said he had recently seen an unusual accident from a B-B shot, the bullet, fired from a slight elevation, at a distance of fifty feet, striking the eye-ball and lodging in the inferior cul-de-sac, whence it was easily removed by slightly everting the lower lid. The eye-ball itself had escaped injury, with the exception of a rupture of the choroid and injury to the overlying retina.

Dr. T. A. O'Brien stated that he had treated 2 cases of gun-shot wound, the first with no pathology except a subconjunctival hemorrhage, the shot being found in the cul-de-sac; the second with penetration of the globe at 12 o'clock, back of the limbus with a detachment of retina and retinal hemorrhages. The shot lodged retrobulbar, as verified by *x*-ray.

Dr. Krauss said that it was interesting that the several cases mentioned, which were struck with a B-B shot, exhibited no penetrating wounds, but the injuries all resulted from concussion. He had seen 4 eyes which had been struck with such missiles, none of which had penetrated; he considered penetration unusual.

Dr. Zentmayer asked whether the iridocyclitis was severe enough to explain the papillitis, it being a common observation that inflammation in the anterior segment of the eye is often accompanied by involvement of the optic nerve.

Dr. McCluney Radcliffe reported a case where a buckshot thrown by a slingshot from a distance of fifty feet penetrated the eye-ball with little or no loss of vitreous. The case was seen several weeks after the accident, at which time the eye-ball was enucleated.

Bilateral Metastatic Ophthalmitis

Dr. T. A. O'Brien presented the case of a retired locomotive engineer, aged sixty-nine years, who in November, 1923, while reading a newspaper, experienced sudden pain in the right eye with impairment of vision, followed in the evening by a similar

attack in the left eye. Within twenty-four hours vision was reduced to light perception in each eye. Examination of the right eye revealed a soft, boggy edema of the lids, extending to the maxillary prominence of the cheek; conjunctiva reddened and chemotic; orbital chamber shallow; aqueous cloudy and hypopyon below; iris swollen and discolored, with indistinct surface markings. Pupil, 3 mm., fixed and slightly irregular, with strings of light brownish exudate in the pupillary area. Fundus invisible. Tension +. The left eye exhibited similar signs, except that the chemosis was not as marked and a few precipitates were observed on the posterior surface of the cornea.

Examination revealed pyorrhea and many abscessed teeth, which were promptly treated; deflected septum on the right side, with hypertrophy of the left middle turbinate, which obstructed drainage and aeration of the frontal sinus; pus in the frontal sinus, which was removed intranasally; anterior ethmoids were drained, but washings from maxillary sinuses were found clear; left tonsil showed a small amount of pus. Under appropriate local and general treatment the condition of the eyes improved slightly, with moderate appreciation of vision; but against the advice of the staff the patient left the hospital seven days following admission and died one week later from meningitis, probably of metastatic origin.

Dr. Luther C. Peter stated that in the last epidemic of influenza he had the opportunity of observing 2 cases of metastatic ophthalmia, both unilateral. In each the eye was totally lost, as the metastatic condition went to suppuration. In the first case the intraocular abscess was well walled off. Three stabs of the eye-ball were made before the abscessed cavity was reached. During that same epidemic, and at about the same time, a case of acute glaucoma was observed, precipitated by an attack of influenza. It appeared on the fifth day of the disease. An iridectomy was necessary. One year later the same patient developed acute glaucoma in the other eye at the height of a second attack of influenza, for which an iridectomy was required.

Embolism of the Central Artery of the Retina during an Attack of Chorea

Dr. H. Maxwell Langdon exhibited a school-girl, aged eleven years, with choking of the central artery of the retina. He said that, undoubtedly, cases were so rare and the underlying series of events which made for the production of the embolus so unusual, that it seemed worth while to report the case. Of all cases which had been reported up to about 1912, Mr. Coats, on pathological examination, would accept as authentic but 5 cases, placing the others all in the class of thrombus formation. Harms felt that for a case to be accepted as embolic in etiology that the vessels should be practically normal and there should be some site which might be productive of an embolus. In this child both demands are met, the vessels are perfectly normal and she has an endocarditis, whence the embolus undoubtedly originated. Of course, one of the interesting points of an embolus of the central artery is the white cloud which forms in the temporal portion of the retina, which has been usually attributed to edema of the retina, but which Coats believed to be due to ischemic necrosis.

Dr. S. Lewis Ziegler stated that he had at present under treatment 2 typical cases of embolism of the central retinal artery. Each showed positive evidence of focal infection in the shape of boils, but dental radiography was negative and other sources could not be demonstrated.

The first case had received daily treatments with positive galvanism and bulbar massage for three months, when the red spot, edema, and other symptoms disappeared. Vision was 5/200, eccentric fixation, but improved to 20/70, J–14, with central vision regained. After a month's rest the galvanic current was reversed to the negative pole and two months' additional treatment administered. The fields have now widened to 40 deg. and vision has improved to 20/30 and J-4.

The second case was first seen two months ago, with peripheral light projection. With bulbar massage and plus galvanism on

alternate days, vision rapidly improved to 4/200, with eccentric fixation. At the end of two weeks the edema had about disappeared and the nerve head began to show atrophic changes, with pallor. The current was then reversed to the negative pole in order to stimulate. Today vision is 6/200, with central vision slowly returning. The disc is still pale, but fine vascularization is reappearing. He thought the earlier the treatment was begun the better the result. The first case was seen within a few days; the second case after ten days had elapsed. Apparently daily treatments yielded better results than alternating days.

He recalled a case, seen thirty-five years ago, of double embolism in which the clot seemed to hover around in the vessel and to intermittently obscure vision before finally causing occlusion. The same type of electric treatment was instituted with restoration of useful vision. Many other cases had responded to similar treatment. He thought, therefore, that the prognosis should never be made a hopeless one.

Dr. L. Waller Deichler thought that embolism of the central artery of the retina, though not a common condition, was not rare. Last September he had treated a young man, aged thirty years, who, two days before, had loss of sight in the right eye. Examination revealed no light perception, with embolus of the central artery of the retina. There was an accompanying endocarditis. This latter condition was the probable source of the embolus, an opinion substantiated by two consultants.

Dr. Luther C. Peter said that Dr. Langdon's paper recalled 3 interesting cases: The first had a valvular heart lesion, but only the inferior branches of the retinal artery were involved. The patient, aged eighteen years, while being fitted for a dress, suddenly experienced sharp pain in the eye and vision became blank. The appearance of the fundus, when last seen about four years ago, showed the inferior part of the nerve head with the usual atrophy, minute vessels and marked pallor. The upper part of the nerve head appeared normal. The fields showed complete loss of the upper half down to the horizontal meridian. The preserved field had full limits. Notwithstanding this loss, the patient has continued to have full 6/5 vision.

The other 2 cases were not unlike the case reported by Dr. Zentmayer of embolism of the cilioretinal vessel as far as etiology is concerned, except that the macular twigs were the seat of an embolus instead of the cilioretinal vessel. The first case occurred in a young man who had been discharged from the service in the late war with a clean bill of health. Four months after his discharge he suddenly experienced pain in the right eye, with complete loss of vision. The patient was seen a few hours after its occurrence. The fundus was pale throughout and details could only be made out with difficulty. Ultimately there developed in the area supplied by the macular artery an atrophic, well-defined zone. The patient had a large central scotoma corresponding to the atrophic area. Peripheral vision was undisturbed. A Wassermann test in this case proved to be positive.

The second case occurred in a healthy young man, who, while working in front of a blast furnace, suddenly experienced pain and loss of vision. He ultimately recovered vision in the peripheral field with a central scotoma. The etiology of the embolus was undetermined.

Dr. Frederick Leavitt said that the case exhibited by Dr. Langdon had been under his care since August, 1923, with generalized choreiform movements of the entire body. All of the usual physical tests were negative. The child was kept in bed until October 1. Shortly afterward there developed tachycardia and a distinct rough systolic murmur. Rest in bed relieved the chorea, the heart action became regular, but the murmur persisted. Up to January 13 the child was not seen, but on that date the mother came to the hospital with her and stated that she had been perfectly well until two days previously, when upon arising she complained of loss of vision in the right eye. The child had no symptoms other than inability to see, although she could recognize bright light when flashed directly in the eye. Dr. Langdon was then called in consultation.

Dr. Zentmayer said that Dr. Langdon should have stated that the apparent infrequency of embolic obstruction, based by Coats on pathologic examinations, has no bearing on the frequency

of the condition, judged by clinical symptoms. He cited a case, previously reported, where a young man, who had lost one eye from gonococcal ophthalmia, some years later had an obstruction to a cilioretinal vessel supplying the macular region. At the time of the occurrence of this latter symptom he had a synovitis and endocarditis. Clinically, this would seem to be a case of embolism.

MARCH 19

Exhibition of Special Protective Goggles

Dr. McCluney Radcliffe exhibited a pair of protective goggles in which the patient's correcting lenses were mounted in separate cells back of the unbreakable lenses of the goggles. The correcting lenses are held in place by a small projection on the temporal side of the cells fitting into a slot in the goggle frames and fastened down by the side protectors or blinders. The lenses are marked with R and L at the upper temporal margins, which ensure the proper insertion in the frames. The frames are set rather low and angular, which prevents the foreign bodies from flying under the frames and nicking the lenses.

One patient, an electric welder, had been using the goggles with his correction (R. E. sph. + 75 ⌒ cyl. + 1.50 ax. 105 deg.; L. E. sph. + 1.25 ⌒ cyl. + 1 ax. 90 deg.) for two months, with entire satisfaction. There were no nicks nor specks on the correcting lenses.

Dr. Howard F. Hansell suggested as a substitution for the shields of crown glass the harder, though more brittle, crystal glass.

Dr. G. S. Crampton stated, in this connection, that a test of the eye-grounds, fields and blind spots of fifteen electric welders using the iron arc on street railway intersections resulted in negative findings, although some of the men examined had been at the work a number of years. These men used variously colored protective glasses. Usually two colored glasses, such as red and blue, were combined with a clear front glass to catch the metallic

splash, the latter glass being frequently renewed. The men admitted occasional accidental exposure to the unshielded iron arc, from which they felt no bad effects unless the action was prolonged, when they experienced the usual delayed effects of an ultraviolet burn.

Unusual Case of Congenital Cataract

Dr. Leighton F. Appleman showed a case of congenital cataract over which, upon dilating the pupil, a leash of fine bloodvessels could be seen. These vessels were thought to be remains of the tunica vasculosa of the undeveloped lens. Detailed study of the case had not been made, as it was seen for the first time but a few hours previously.

Accommodation in Myopia

Dr. Howard F. Hansell considered the comparative effect of the contraction of the circular and radiating fibers of the ciliary muscle in the production of accommodation. The radiating fibers are overdeveloped in myopia and the circular fibers in hyperopia, according to the illustration of microscopic slides, originally of Arlt and reproduced in many text-books. The result of the contraction of the former, especially in myopia, is not generally understood; that they play an important part seems obvious from their greater number and volume. Dr. Hansell believed that the myopic eye cannot be considered as a perfectly sound eye, to be treated on the same lines as an emmetropic eye. He deprecated the exercise and enforced use of accommodation, and advocated partial correction for the near-point. The full correction should be reduced according to age, occupation, degree of myopia and the previous use of glasses, and this applies in most cases of myopia of 3 D. or over.

Dr. William Zentmayer stated that at the time he entered ophthalmology the full correction of myopia was being advocated, and he adopted it and has continued it, so that he has had no

experience as to the relative value of the two methods in controlling the progress of the myopia. When patients with myopia are seen early in life they will be comfortable with full correction no matter how high the degree. It would seem that the disturbed relation between accommodation and convergence produced by a partial correction would be more likely to cause discomfort.

As to a myopic eye above a certain degree having no accommodative power, Dr. Zentmayer said that over thirty years ago Dr. James Wallace published a paper showing that myopic persons, even of a high degree, often have, when corrected, a near-point closer than the average for their age. He did not, as Dr. Zentmayer recalled, give an explanation which involved the consideration of the ciliary muscle. Occasionally those with high myopia, with extensive choroidal atrophy, are uncomfortable with full correction, the images being too sharp and distinct. These are at once made comfortable by partial correction and assisted by the instillation into the eyes of a weak pilocarpin solution.

Dr. G. S. Crampton referred to a case of high myopia in a man, aged thirty years, whose correction of —20.00 spherical with a —1.25 cylinder gave him full vision and comfort in both distant and near use.

Dr. E. B. Miller believed that each case must be studied on its own merit. He referred to a young woman whom he had first examined for glasses ten years ago. She was wearing sph. —21 in each eye, with a cylinder correction, and read 20/40. His refraction was O. D. sph. —21 ⌒ cyl. —3 ax. 60 deg. and O. S. sph. —21 ⌒ cyl. —2.75 ax. 120 deg., which gave her 20/30 vision in each eye and 75 D. T. for near. With these she had comfortable vision. Later she was refracted on two occasions by others, who felt that the strength of the lenses should be reduced to give her better near vision. A few days ago she again reported and said that her glasses were not comfortable. Vision was 20/70 and 20/200. With O. D., sph. —22 ⌒ cyl. —3, ax. 55 deg. and O. S. sph. — 23 ⌒ cyl. — 125 ax. 130 deg., vision was 20/40 in each eye and 75 D. T. for near. These glasses were comfortable and are used for both near and distance. In addition to a sister, who

had a similar experience, he had seen a number of other cases of high myopia who wear the same high refraction for near and distance with comfort.

Industrial Compensation in Pennsylvania for Eye Injuries

Dr. William M. Sweet gave a presentation of the Workmen's Compensation Law of Pennsylvania, with reference to injuries of the eye as interpreted by the referees and Compensation Board of the state and by the courts. The cases were divided for study into two general groups: (1) Those cases in which, as a result of injury, there was a partial reduction of vision not improved by glasses, and (2) cases in which there was marked reduction of vision that could be brought up to practically normal sight with glasses, but the lenses could not be worn, owing to the lack of coördination of the two eyes when the strong glass was before the injured eye. This latter group dealt with cases of traumatic cataract, the individual, after removal of the injured lens, secured practically normal sight with a glass. A number of cases were cited of hearings before referees, with final decision of the Compensation Board.

As an example of the first group the history was detailed of a machinist who suffered a reduction of vision of the right eye to 20/50, and who claimed that on account of the diminished sight he could not work as a machinist at the particular kind of work he had been doing at the time of injury. The Compensation Board awarded full compensation as provided by the Act, and this was confirmed by a Common Pleas Court. The case came before the Superior Court on appeal, and the justice said that unless the man could establish the loss of the use of the eye he was not within the provisions of the law compensating him for such loss; that a man had not lost the use of an eye when the impairment of vision was not sufficient to disqualify him for employment for which he is mentally and physically qualified; that there is evidence that he cannot now perform a certain kind of work he performed as a machinist, but that limited disability does not

bring him within the provisions of the Act for the loss of the use of the eye. The court, therefore, reversed the award of the Compensation Board.

In the second group of cases were given the histories of several cases in which a traumatic cataract was removed, with restoration of practically normal sight with the aid of a glass. In these cases the referees of the Compensation Board ruled that there was loss of the use of the eye, since the individual could not wear the glass which restored vision, owing to lack of coördination of the two eyes with the strong glass before the injured eye to compensate for the cataract removed. In one of the cases which came before a Common Pleas Court on appeal the judge quoted the opinion of the Appellate Court of New York, as there was no decision of an Appellate Court of Pennsylvania, that through the use of an artificial lens the eye could fulfil the natural functions of an eye, and that the man had permanently lost the use of the eye when so supplemented to the extent only of using it in conjunction with the other eye, which he could not do, owing to lack of coördination of images. Should the left eye be lost he would be able, using the injured eye aided by a lens, to fully perform his duties. The court, therefore, ruled that the individual had not lost the use of the eye.

Within the past month the question has come before the Superior Court of Pennsylvania in an appeal from an award of full compensation for injury by a miner, in whom, following removal of a traumatic cataract, the man secured 96 per cent of normal vision. In reversing the award of the Compensation Board the justice said that while the loss of the lens of the eye was a serious injury, and that it detracted from the value of the eye, the eye was not lost, for if the man should lose his other eye he would be able, using the injured eye aided by a glass, to fully perform his duties. Under the theory adopted by the Compensation Board it would be possible for the individual to be twice awarded full compensation for the loss of each of his eyes, for the other eye could be injured as the first one was and the vision corrected by a lens, and then the two eyes could be absolutely destroyed by accident. While

this was a remote possibility, the justice said that no one would object more vigorously than the individual if, following a similar injury to his previously good eye, and the possession of normal vision in both eyes used separately, it should be held that he could not be compensated for future injury to either eye, because both had been judiciously determined to have been lost.

Dr. George H. Cross said that Dr. Sweet's *résumé* of the compensation value of an aphakic eye is so complete that it leaves little for one to discuss. It does seem rather unfortunate that an injured person should receive no compensation other than for time and medical service while under treatment for the loss of the crystalline lens. Under the all or none provision of the present law, it seems to have been the general tendency of referees to favor the injured party. Many are of the opinion that if there were a graded schedule of compensation adjusted on the basis of the percentage loss of vision it would be far more equable.

He cited an unusual finding that was made in a case in which he was interested: A bricklayer fell about fifteen feet, receiving a fractured skull. Following his recovery there remained a complete paralysis of one of the ocular muscles, which later improved greatly, so that in the erect posture the vision straight ahead was 20/20. His occupation, however, necessitated looking down, and in doing so he had a marked diplopia. As a result of this he was awarded damages for the total loss of the eye.

At the present time a Commission on Compensation Law, appointed by the president of the Medical Society of the State of Pennsylvania, is endeavoring to obtain expressions of opinion from medical men throughout the state in order that there may be presented to the next Legislature a modification of the present compensation laws which will more adequately protect the surgeon or medical man in charge of the case. Those of us having definite views on this important subject should forward them to the above commission, of which Dr. M. A. Slocum, of Pittsburg, is secretary.

Dr. H. Maxwell Langdon remarked that, as Dr. Sweet says, it did not seem fair to compel an employer to pay for the complete

loss of an eye which has suffered the loss of the lens only. It is potentially a very useful eye, and as he has brought out in his paper where this is done and the eye is used with a correcting lens and again suffers injury, with the result that enucleation is necessary, the man might easily be paid twice for the loss of the same eye. According to the Pennsylvania law the referees have no choice but to award compensation for the complete loss of an eye or give him nothing, as there is no gradation in the scale. If the law in this state were like that of New Jersey it would be possible to award compensation on the basis of a partial loss of the usefulness of an eye, and much of the present controversy would be abolished, as the referees naturally feel that the man is entitled to some award, and therefore do their best under the circumstances.

Dr. T. B. Holloway thought there were certain phases that should be corrected by the medical profession in the state before asking the state to put its own house in order. What particular method should be adopted for estimating the extent of the injury and the amount of compensation that should be awarded? A number of different plans were referred to that have been advocated in recent years, certain of them being quite complicated.

Siderosis Bulbi with Dilated Inactive Pupil

Dr. William M. Sweet exhibited a young man, aged twenty-three years, who received a penetrating wound of the left eye June 28, 1923, with lodgment of a small piece of steel in the vitreous chamber. Six months later there was brownish discoloration of the iris, pupil 6.5 mm. and unresponsive to light or in accommodation, degeneration of the anterior portion of the choroid below, diffuse haze of the vitreous and vision 20/40. An *x*-ray localization showed a fragment of steel, 3 x 1 mm., situated in the lower portion of the vitreous chamber near the vertical plane and close to the ciliary body. In February last the steel was removed through a narrow opening in the sclera in the lower outer portion, which was then closed with conjunctiva. Six weeks later the eye

was quiet, the pupil reacted 1.5 mm. to direct light, the discoloration of the iris was slowly disappearing and vision with a lens was 20/20 partly.

Dr. Sweet referred to an identical case reported in a paper by Dr. Nelson M. Black, of Milwaukee, at the last meeting of the American Ophthalmological Society. In this case there was return of the contractile power of the iris and lessening of the iris discoloration after removal of the steel. In the paper of Dr. Black was given the various theories for the siderosis and the inaction of the pupil, and in addition a photographic section of an iris showing the iron pigmentation in a case of siderosis studied by Dr. Verhoeff. In Dr. Verhoeff's opinion impaired motility of the iris is not due to selective action on nerve terminals, but to impairment in function of the muscles of the iris resulting from their affinity for iron.

In answer to a question by Dr. Turner as to the reason for the steel not having been covered with exudation after remaining in the eye for so long a time, Dr. Sweet said it is often possible for the operator, from a study of the situation of the entrance wound and the location of the steel, as shown by the *x*-ray, to judge whether the metal will be secured with the magnet. Many small fragments pass through the anterior section of the globe and drop to the bottom of the vitreous, and in this situation will remain for a long period without becoming embedded in the tissues. These pieces offer no difficulty in extraction even after remaining in the eye for months or years, whereas a metal particle that passes from the entrance wound to become caught in the retina or choroid at the posterior portion of the vitreous chamber may be so firmly bound up in fibrous exudate inside of a week as to prevent extraction by even the strongest magnet.

A Case of Pulsating Exophthalmos

Dr. William Zentmayer reported a case of a woman, aged forty years, who was seen at the Wills Hospital for the first time January 28, 1924. Vision, O. D., 4/60, corrected to 6/30; O. S.,

6/60, corrected to 6/9. She was in an automobile accident in July, 1923, and sustained a fracture of the base of the skull. Both eyes, but most markedly the left, became prominent at that time. The protrusion was, in the beginning, greater while lying down. The patient complained of a noise in the left ear with each heart beat. Four years ago she had facial palsy. Right eye was turned in in childhood. Now, left eye a relative exophthalmos of 5 mm. measured with a Hertel exophthalmometer. Marked dilatation of the conjunctival vessels and of the orbital veins. Pulsation of the globe can at times be made out. There was decided limitation of the outward excursion and slight limitation in other directions. There was a narrow linear opacity in the lower outer quadrant of the cornea.

Ophthalmoscope: Left eye, all about the disc intense striation of the retina, probably due to the persistence of medullary fibers; retinal vessels greatly dilated and extremely tortuous, especially the superior; arteries normal. Right eye, a narrow girdle of opaque nerve fibers encircling all but the temporal third of the disc, of pretty even width throughout, but at the upper portion especially there are numerous feathery prolongations beyond the more opaque zone.

There has been nothing added to the symptomatology of this condition since the interesting monograph by de Schweinitz and Holloway, which contains an analysis of most of the cases in literature not previously tabulated at the time of their publication in 1907. Several authors have from time to time brought the tabulation up to date—Bedell, Zentmayer and Whitham.

The conclusions of de Schweinitz and Holloway concerning the treatment of the affection have not apparently gained acceptance. They were of the opinion that ligation of the superior orbital vein should be first done. The method of choice seems to be ligation of the common or internal carotid artery. The danger to the brain appears to have been overcome by so-called slow ligation. The ligation of the orbital veins also is not without danger, as fatal results and secondary hemorrhage have occurred at least once each.

Dr. C. E. G. Shannon gave the history of a case he had examined at the request of Dr. Thomas A. Shallow. The man had been admitted to the Jefferson Hospital in January, 1924, with a history of an automobile accident four months previously, which caused severe contusions of the head and body, but not unconsciousness. Immediately following the accident he noticed a whirring or blowing on the right side of the head coincident with the systolic beat of the heart. Three months after the accident a swelling was observed in the region of the right orbit, which increased gradually, until at the time of his admission to the hospital all the symptoms of a typical traumatic pulsating exophthalmos were noted: upper lid swollen; lower tarsal conjunctiva markedly chemotic; eye-ball proptosed about 10 mm. and immobile; cornea clear but anesthetic. Ophthalmoscope: media clear; disc swollen and engorged; entire retina hazy; two small areas of inflammatory edema in the macula region and veins extremely dilated and tortuous, especially the superior and inferior temporal. Vision reduced to counting fingers at two feet. Palpation over the right eye-ball revealed pulsation and a thrill and auscultation a distinct bruit.

Dr. Shallow ligated the common carotid one inch below the point of bifurcation two days after the man entered the hospital. On the following day there was complete absence of pulsation and bruit and the patient stated the noise on the right side of the head had ceased. The swelling of the lids and the proptosis gradually receded, and three months following the operation the exophthalmometer revealed recession of the proptosis from 10 to 5 mm. and the swelling of the lids reduced to almost normal. The patient has been comfortable since the operation.

Dr. T. B. Holloway stated that what was said about the orbital operation was correct at the time it was written. He pointed out that ligation of the common carotid was not free from cerebral complications and that the statistics of Siegrist give an incidence of about 8 per cent. Still further, in a few instances, ocular complications have arisen. It is true that these statistics run back for years and that local conditions, such as infection and secondary hemorrhage, are now less frequently encountered. On the other hand, he questioned whether the observations concerning cerebral

complications were as accurately recorded as those following ligation of the orbital vein.

Dr. Holloway stated that he could only repeat a previous statement to the effect that if he should develop a pulsating exophthalmos he would probably prefer a slow ligation of the common carotid, but certainly a ligation of the orbital vein before a ligation of the other carotid. After all was said a number of factors should determine the character of the treatment, such as the age of the patient, the extent and character of the injury, the associated medical conditions and the local signs.

Dr. Zentmayer said that he thought Dr. Holloway touched on the important point in the management of these cases when he said that it depended somewhat on the degree of exophthalmos and the general condition of the patient. The case which he had just shown was not greatly annoyed by the bruit, the exophthalmos is not extreme, and there is neither disfiguring chemoses nor redness of the conjunctiva, so that he had not strongly urged a radical procedure and the patient did not feel that she would care to submit to an operation which might prove serious.

A Case of Mikulicz's Disease. Exhibition of Case

Dr. John P. O'Brien exhibited a case of Mikulicz's disease in a colored woman, aged twenty-four years. Examination revealed enlarged lacrimal and parotid glands, otherwise the physical examination was negative. History showed no tuberculosis; no miscarriages; von Pirquet slightly positive; Wassermann negative; urinalysis, trace of albumin; leukocytosis, 12,000; differential, normal; red cells, 3,320,000; hemoglobin, 65 per cent; fundus negative. Treatment, tonics and hygienic.

Dr. S. Lewis Ziegler stated that he had personally observed 5 cases of Mikulicz's disease and had reported 3 cases. The characteristic sign of "bloodhound facies," which he had called attention to, was absent in this case, as the lacrimal glands alone were decidedly enlarged, but the parotids were only slightly more prominent than usual. The other glands were negative.

He thought it was always necessary to search for respiratory obstruction, and to treat it if indicated, so as to relieve the suboxidation which caused the glandular hypertrophy. He had found such lesions in all his cases and had relieved 2 by tonsillectomy and 1 by nasal cauterization. The other 2 were referred to the rhinologist for similar treatment, but he did not know the final result. He thought a similar examination in this case might reveal some obstruction to breathing that might prove to be a causative factor.

APRIL 17

A Case of Bilateral Congenital Palsy of the External Rectus. Two Cases of Irideremia

Dr. H. Maxwell Langdon exhibited a boy, aged ten years, who had had convergence of his visual axes, with inability to rotate the eyes outward, from birth. The boy is healthy in all other respects. The visual fields and pupillary reactions are normal. Ocular rotations are full and equal in all directions, with the exception of the palsy of the external recti. These cases are at times due to faulty insertion of the muscle or to absence of the muscle rather than a lesion of the nervous system. In the present case the cause of the condition is not known, as no operative procedures have been attempted.

Dr. Langdon also exhibited two case of irideremia: Mrs. J. T., aged thirty-two years, and her brother, A. J., aged twenty-six years. The former had almost complete irideremia. The brother had, however, no external signs of the presence of any iris tissue. The mother had the same condition as did the grandfather, the great-grandmother and the great-great-grandmother. The man has a corrected vision of 5/10 in each eye; the media are clear; the fundus apparently normal; and in the right eye the suspensory ligament of the lens is seen down and in. The sister has corneal scars from former ulcerations, with some lenticular

haze. Vision, right eye, 5/60; left eye, hand motions at one foot. A poor view of either fundus was obtained. Tension, right eye, with the Schiotz tenomater, 38 hg. mm; left eye, 58 hg. mm. It was impossible to use a myotic or to attempt iridectomy, and an Elliott trephining operation was performed. The conjunctival flap was separated without trouble, but the sclera was found to be rather spongy instead of the fibrous normal tissue, and, while attempting to split the limbus, a sudden gap in the sclera appeared to the outer side of the area, which was being separated, through which fluid vitreous immediately oozed. As this was immediately back of the limbus the opening was over what would have been the posterior chamber had the iris been present, and it seemed possible that the fact that vitreous came through so freely explained the increased tension, making it probable that there was vitreous in the anterior chamber as well, which, on account of its increased viscosity, could not be filtered in a normal way. Mr. Treacher Collins has reported cases of apparent irideremia in which a root of the iris was found that blocked the angle, and this may be the explanation in the present case, though it seems that the condition of the vitreous is quite sufficient to account for the high tension.

Dr. William Zentmayer said that a few years ago he showed before the Section a child, mother and grandmother, all with unilateral congenital palsy of the external rectus.

Dr. William Campbell Posey stated that, *apropos* of glaucoma in aniridia, he recalled the classic case of Treacher Collins of glaucoma with aniridia, in which no trace of the iris could be found clinically, but after the removal of the eye the microscope showed the root to be present and adherent to the cornea, blocking the angle of the anterior chamber. He thought it was now generally accepted that in all cases of congenital aniridia with glaucoma similar rudiments of the iris were present.

Dr. T. B. Holloway stated that in the cases of aniridia heredity was a conspicuous factor. He alluded to the most unusual instance of this kind that was recorded before this Section by the late Dr. Risley. In a case that he personally had placed on record before this Section it was impossible to definitely determine any

hereditary taint, and in another case, now under observation, it was impossible to elicit any definite information in regard to this. He felt, as Dr. Posey has stated, that even where clinically the iris appears to be wholly deficient, there is usually a stump remaining with certain pathologic changes at the angle that gives rise to the glaucoma, which not infrequently is present, and which was evident in the case he reported before the Section.

The Pathogenesis of the Vossius Ring Cataract

Dr. William Zentmayer stated that Vossius, who first described this condition, attributed it to an impress of the pupillary border of the iris on the anterior capsule of the lens, the lesion consisting in part of detached iris pigment and in part of changes in the anterior lens capsule and in the anterior layers of the lens. The view now commonly held is that the impress of the iris results from increased tension in the anterior chamber from the contusion. Hesse, from slit-lamp study, concludes that the lesion consists not alone of the ring, but of a disciform opacity which becomes thinner as the center of the pupillary area is reached.

The following case supports Hesse's view: While doing an advancement the needle was entered too deeply and was followed by a trickling of blood over the anterior surface of a portion of the iris and of the pupillary area, not sufficient to produce a hyphemia. There was no undue reaction, but when the eye was examined with the ophthalmoscope, about ten days later, there was a typical Vossius ring cataract. Because of the irritability of the eye it was impossible to make a satisfactory study of it with the slit microscope. As this occurred without a contusion, it follows that it arose from a deposition of blood on the anterior capsule.

Dr. T. B. Holloway said that, as is well known, this type of cataract is not only caused by contusions to the anterior part of the eye, but that penetrating injuries posterior to the lens are also followed by similar manifestations. He stated that at a recent meeting he had referred to his studies of a case by means

of the corneal microscope with slit-lamp illumination, in which the observations of Hesse were confirmed. He thought the case history cited by Dr. Zentmayer was particularly interesting and unique, and it seemed to have a definite bearing on some of the more recent views in regard to the etiology of this type of cataract.

A Case of Antimetropia. A Case of Oculomotor Palsy with Unusual Manifestations. Associated Contralateral Eye-ear Movement

Dr. Warren S. Reese exhibited a case of antimetropia. Under homatropin the patient took the following: R. E. sph. — 1.75 = 6/9 +; L. E., sph. + 1.75 = 6/6. At postcycloplegic examination it was necessary to add spherical — 1.25 to the cycloplegic findings for each eye, to secure the vision obtained under cycloplegia. In the right eye there was apparently a latent hyperopia in a myopic eye and of the same degree as the latent hyperopia in the hyperopic eye. Probably the myopic eye was accommodating synergically with the hyperopic eye, since there was slightly better vision in the latter eye.

Dr. Reese also exhibited a case of oculomotor palsy in which all the extrinsic muscles were involved except the left externus and left superior oblique. The preservation of this latter muscle was shown when the patient attempted to look down, whereupon the affected eye rotated markedly in a counter-clockwise manner. There was also iridoplegia and cycloplegia. The unusual features of the case were (1) on looking to the left the ptosis became much more marked; (2) on looking down the affected upper lid moved up; (3) on attempting to look up the left eye turned in even better than when the patient attempted to look to the extreme right.

Dr. Reese exhibited a case of associated contralateral eye-ear movement. On extreme lateral rotation of the eyes to the left the right ear moved in. This also occurred on extreme lateral rotation to the right, though to a much less degree. The same movement of the left ear occurred on extreme lateral rotation to the right. The patient was unable to move his ears voluntarily

and had not been conscious of this peculiar associated movement until his attention was called to it.

Dr. William Zentmayer inquired, in the case of oculomotor palsy, if there was a history of migraine? If so, with the history of recurrence of the palsy it would suggest the case to be one of ophthalmic migraine.

Dr. Edwin B. Miller stated that the case of oculomotor palsy was seen by him two months previously at the Polyclinic Hospital. At that time he was suffering from severe headache associated with complete third-nerve paralysis of the left eye—ptosis, eye deviated down and out, and, on attempted downward rotation, distinct intortion from action of the superior oblique. The pupil was dilated and fixed. The lifting of the left lid with downward rotation of the eye was not noted at the first examination. Neurologic report negative, as well as all laboratory tests. In a few days the headache subsided and the eyelid returned to normal. The patient stated that in the last two years he had had several similar attacks. A diagnosis of ophthalmic migraine was made. At the present time there is a partial recovery of the third nerve palsy, with improvement of the ptosis.

Dr. William Campbell Posey asked if the muscle balance had been studied. Some years ago, in tabulating a number of cases of anisometropia, he was surprised to find that, although conditions obtain in this class of cases which would favor muscle imbalance, *i. e.*, difference in the length of the eyes, frequent dissimilar insertion of extraocular muscles into the globe, orbits of different shapes, etc., the muscle balance was in nearly all the cases practically normal.

Dr. Zentmayer said that the case of ear-wagging belonged to an interesting group, exhibiting many combinations, of which perhaps the jaw-winking type is the most common. Other variations are spasm of the orbicularis during mastication, a case of which was reported by Harlan; paralysis of accommodation during mastication; contraction of the frontalis associated with abduction; contraction of the levator associated with abduction or adduction,

and retraction of the globe either in abduction or adduction. It has been suggested that some of these cases are atavistic, as, in certain of the lower animals, groups of muscles which in the human have separate innervation are all innervated from the same center, the supposition being that in these cases there has been a failure of differentiation of muscles. Harman states that 20 per cent of all individuals show that elevation of the alæ of the nose accompanies normal blinking.

Dr. Langdon said that some years ago Mr. N. Bishop Harman, of London, for many years connected with the anatomical department of Cambridge University, wrote a very interesting article, which was published in the *Transactions of the Ophthalmological Society of the United Kingdom*, on comparative anatomy as an explanation for some of these movements.

Dr. Holloway stated that a number of years ago he had placed on record before this Section the history of a case of jaw-winking. At that time he cited the various theories of Sinclair, Gunn and others, and certain of these observers had alluded to just the type case that Dr. Reese had shown, *i. e.*, the association of ear movements with the rotations of the globes. It was interesting to note that in the case under discussion, when the eyes were rotated to the left the right ear retracted. From certain viewpoints one might expect the ear to be turned in the same direction as the eyes.

Unusual Hole in the Fundus

Dr. Hunter W. Scarlett exhibited a young woman who showed an unusual hole in the fundus. The patient, Miss C., came for examination for glasses. On routine examination a large circular hole was seen in the right fundus down and out from the disc about 1½ disc diameters. The depth of this hole amounted to about 3 or 4 diopters. If was surrounded at the inferior border by a small amount of pigment. The bottom of the hole was stippled with brownish pigment, while coursing along its side, about half-way down, was a choroidal vessel. A small patch

of choroiditis was situated to the temporal side of this hole. Vision, 20/30, corrected to 20/20. No history of injury, inflammation or general illness could be elicited. The probable cause was a localized choroiditis.

A Note Concerning a Course in Optics as Applied to Ophthalmology

Dr. Alfred Cowan said that in 1921 there was begun in the Graduate School of Medicine of the University of Pennsylvania a regular systematic course in optics. There was no attempt to cover the whole field of optics, but rather to carry out the plan of Landolt and explain those facts which are considered indispensable to an ophthalmologist. As far as was known there was no precedent for a year's course of this kind, and, for this reason, no book could be found that adequately covered the subject. For the first part the works of Clay, Glazebrook, Ganot, Carhart, Prentice, Southall, Heath, and for the later part, Young, Helmholtz, Donders, Landolt, Tscherning, Duane and others were freely used and modified.

The apparatus is simple, the most important of which is an optical bench and the necessary equipment. All the apparatus is given out at the beginning of the course. The men work in pairs, two pairs at one large table, on each side of which is an electric outlet and two lockers.

Each experiment is explained by models and specially drawn charts, and performed with the same kind of apparatus that is used by the student. From the result of the experiment is deduced the theoretical consequences. Their application to ophthalmological instruments and to the eye are kept constantly in the mind of the student. The formulæ are mostly the same as are used later, since uniform notations are employed throughout the course. Every effort is made to simplify the subject, and no man need be a mathematician, but some knowledge of mathematics is absolutely necessary in the study of optics.

In the beginning is studied the nature of light, luminous and non-luminous bodies, media, shadows, intensity of light and photometry. Simple experiments with pins are done to prove the laws of reflection and refraction at plane surfaces, first one, then two, parallel and inclined at an angle. This brings prisms and their numeration to the consideration of the student. Much detail is gone into at this stage of the course, so that the principles that underlie the whole subject of optics may be thoroughly understood.

Experiments are performed on the optical bench to prove the formulæ for principal and conjugate focal distance and the size and shape of the image for mirrors, and the various forms of lenses, and combinations of lenses, with and without a separation.

Next is studied the Gause theory of refraction at a single refracting surface (with always the cornea in mind), then lenses of finite thickness, such as the crystalline, ordinary ophthalmic lenses and the newer forms of lenses. Up to this time the student has been working in reciprocals, so that the dioptric system needs hardly an explanation.

Practical exercises are given in the neutralization of lenses, the use of the protractor and the centering and decentering of lenses, as is done in an optical shop.

As has been said, all considerations have led to the point where could be intelligently studied both the physical and the pathologic optics of an eye as an optical instrument: first, the static and dynamic emmetropic eye, then ametropia and finally the combination of the eye and a lens. And lastly are rehearsed the optical principles of such instruments as are necessary in the daily work of an ophthalmologist, including the ophthalmometer and ophthalmometry, the ophthalmoscope and ophthalmoscopy, the retinoscope and retinoscopy, and the usual trial case accessories.

Dr. T. B. Holloway congratulated Dr. Cowan upon the efficiency of the course he had elaborated, and commented upon the difficulties in making such a course practical as well as interesting. He felt that Dr. Cowan had succeeded in both of these.

OCTOBER 16

Obstruction of the Central Artery of the Retina during the Performing of an Intranasal Operation

Dr. William Zentmayer presented the case of a boy, aged eighteen years, who suddenly lost the sight in the right eye while a right turbinectomy was being performed. The operation was not completed. The patient was put to bed and for five days had light perception only, after which there was a slow recovery of the vision up to 5/15 in a small sector of the upper nasal field. When first seen by Dr. Zentmayer, one year later, the picture was one of embolic atrophy.

There are a number of cases on record of permanent obstructive blindness following the injection of paraffin in the subcutaneous tissue of the nose, and also several cases of transient monocular blindness following the use of the galvanocautery intranasally. The various theories that have been brought forward to explain the blindness, and the manner in which an embolus could reach the retinal circulation, were considered, and the view expressed that the route which the embolus takes is probably in some way more direct than through the pulmonary capillaries.

Dr. Frederick Krauss felt that, in view of the great frequency of operations performed on the middle turbinate bone and other structures in the nose, the rare occurrence of the eye lesion is most likely due to an anatomical anomaly. The os planum is frequently as thin as tissue paper and fragile. An inadvertent pressure or twist of the scissors could cause a fracture with profuse bleeding. The hemorrhage could thus pass backward below the periosteum and press upon the vascular supply of the eye. This thought is further strengthened by the fact that usually the ocular injury is on the same side as the nasal operation.

The cases recorded in Dr. Packard's paper, 1917, are of a different class, as in these recovery took place, while in the paraffin cases the eyes remained blind or nearly blind. He felt that ultimately it will be found the cause is a more direct one than the

supposition of a circuitous passage of the embolus through the lungs.

Dr. B. Alexander Randall stated that he had never seen a case so immediately due to a nasal operation as that cited by Dr. Zentmayer, and felt that any such obstruction must have been toxic rather than an embolic particle from a heart valve detached in a sort of agonal spasm of the myocardium—akin then to de Schweinitz's occlusions of the retinal vessels in his "toxic amblyopias." Ziern's claims of a nasal causation of all sorts of eye troubles had always seemed to him overdrawn, although he had seen, in his experience covering forty years, a few substantiations. Gruening, of New York, was inclined to accept more of them than his own experience justified.

Dr. Zentmayer said that no doubt an intranasal anomaly might lead to a direct involvement of the vascular spaces. It must not be forgotten that the vast majority of these cases of blindness have followed paraffin injections, and there can be very little question that here it is due to an embolus, and probably the same cause applies when it follows an intranasal operation.

Experimental Studies in Immunity in Herpes Simplex

Drs. Sigmund S. Greenbaum and Malcolm J. Harkins detailed the results of studies made at the Research Institute of Cutaneous Medicine in reference to herpes simplex, which is considered a generalized specific infectious disease, with certain localizing symptoms, as shown by experimental observations in both the human subject and in laboratory tests on the rabbit, in whom the active agent, a filterable virus, under certain conditions produces a severe keratoconjunctivitis and in some instances a fatal encephalitis.

The experiments on immunity produced by a previous mild herpetic infection apparently showed that none of the rabbits which had recovered from a mild herpetic virus infection had the slightest immunity of the cornea when reinoculated with a strong herpetic virus, either in the same eye or in the eye opposite

to that previously infected with the mild virus; that a rabbit inoculated thirty-eight days previously with a mild herpetic virus (strain II) did not succumb to an intracerebral inoculation of the stronger virus, whereas the control rabbits developed an encephalitis in eight to fourteen days, respectively; that a rabbit inoculated and recovered fifty days previously from a mild herpetic virus infection developed a keratoconjunctivitis when inoculated with the stronger strain, but did not develop an encephalitis (the control rabbit developed cerebral symptoms in eight days); that three rabbits previously infected with a mild herpetic virus developed a keratoconjunctivitis with cerebral symptoms in from eight to thirteen days after inoculation with the strong herpetic virus. Apparently no immunity had been produced by the previous herpetic infection.

The experiments on induced immunity showed herpetic encephalities in 75 per cent of animals injected subcutaneously with 40 per cent suspension of herpetic brain. One surviving rabbit developed prolonged keratoconjunctivitis and ulcers following corneal inoculation with active virus, and reinoculations of the eye caused marked keratoconjunctivitis with rapid recovery to normal in thirteen days. As many as 12 subcutaneous injections of a 1 per cent suspension of killed herpetic brain virus in 2-cc amounts gave neither corneal nor general immunity, nor did one subcutaneous injection of 1 per cent suspension of living herpetic brain virus confer sufficient immunity to withstand a later corneal inoculation. Two injections of 2 cc of the same vaccine, at six days' interval, did not prevent the development of herpetic encephalitis.

Dr. William Campbell Posey said that Dr. Arnold Knapp had recently informed him that at the last Heidelburg Congress Professor von Szily had reported that he had been able to induce sympathetic ophthalmia experimentally by injecting bacteria taken from a human cornea, the site of herpetic disease, into the ciliary body of a rabbit. Sympathetic inflammation developed in the fellow eye of the rabbit a few weeks later.

Vascular Lesions of the Retina in Young Persons

Dr. Harry Friedenwald (by invitation), showed twenty lantern slides of various vascular retinal lesions, and said that abnormal conditions of the retinal arteries and veins observed in the young are found in association with a number of well-known fundus diseases: (1) Recurrent retinal and vitreous hemorrhages; (2) retinal disease with massive exudation (Coats' disease), including von Hippel's disease; and (3) acute circumscribed exudative chorioretinitis.

1. *Recurrent Retinal and Vitreous Hemorrhages.* He said that many years ago he had described marked changes in the caliber of the retinal vessels, and especially of the veins, constrictions, dilatations, engorgement, the formation of varices and of newly formed vessels projecting into the vitreous in cases of recurrent retinal and vitreous hemorrhages in the young. He described several cases, two of which had been under observation for many years.

2. *Retinal Disease with Massive Exudation.* These cases were first grouped under the above heading by Coats. The vascular anomalies which characterize them are: Tortuous and engorged veins, aneurysmal dilatations and sclerosis of the vessels and perivasculitis. Coats ascribes these conditions to vascular disease and consequent hemorrhages, often profuse, into the external layers of the retina and their subsequent organization, together with degenerative changes in the retina.

Appearances similar to these are found in other conditions. Von Hippel, in 1904, described a curious vascular tumor formation, an angiomatosis retinæ, with disease of the retinal vessels. A similar picture was reported by Knape, but was due to glioma of the retina. We are forced to conclude that these conditions, similar in ophthalmoscopic picture, may be produced by very different underlying lesions.

3. *Acute Circumscribed Exudative Chorioretinitis.* In this affection retinal vascular disease is not infrequently observed. Dr. Friedenwald stated that, in 1902, he described the vascular affec-

tion as a perivasculitis, showing itself in numerous white spots arranged along the sides or upon the surface of the vessels. The vasculitis observed ophthalmoscopically was of the same type as that seen in those of the first group, and this close relationship is also found in the association of acute choroiditis and hemorrhage into retina and vitreous. The condition was ascribed by Axenfeld and Stock to tuberculosis, and Fleischer has brought forward pathological evidence in support of this view.

Conclusion. Vascular disease of the retina is a frequent accompaniment of a number of pathological conditions of the fundus. It must be noted, however, that the vascular lesions seen with the ophthalmoscope are sometimes at a distance from the gross retinal lesion. In some conditions the vascular disease is the cause, as in the hemorrhages into the retina and vitreous and probably in the deep hemorrhages of retinitis with massive exudation; in others, the vascular conditions may be the result of primary retinal disease producing inflammatory and obstructive affections of the vessels. It is not known if the primary vascular disease is at times congenital or under what conditions it develops when acquired, but tuberculosis is believed by many to play an important part.

Dr. Francis H. Adler said that the most striking feature of all these lesions is that they are confined to the veins. In the vascular lesions of later life, especially those associated with arteriosclerosis, hypertension and chronic nephritis, the arterial side of the vascular bed is that which is chiefly involved. Two factors are to be thought of in the production of these arterial lesions, namely, a diseased arterial wall and a raised arterial pressure. Dr. Friedenwald has pointed out the pathologic changes which have been found in the veins of these adolescent hemorrhages. It might be pertinent to investigate whether the venous pressure was elevated in these cases. The use of Bailliart's dynamometer might give valuable information regarding this point.

Dr. Zentmayer said that there are certain cases which come within the first division of Dr. Friedenwald's classification in which the symptoms are so characteristic that they form a definite group. These are the typical relapsing cases of adolescence, occurring

much more frequently in males and most frequently in the left eye, and are associated with massive hemorrhages into the vitreous. Many of these lose useful vision and often become permanently blind in one eye. As to etiology, in 1920, he suggested that such cases might be of endocrine origin. This view has since been expressed by Dr. Fridenburg, Dr. Wilmer and others. Professor Fuchs and Dr. Verhoeff both consider that cases are not always of tuberculous origin.

As to the second group, retinitis with massive exudation, it is probable that circinate retinitis and the class of cases first described by Nettleship belong with this group. Nettleship's cases occurred in children, following measles or one of the other exanthemata. The retina, which contains thickened plaques, became detached from subretinal and intraretinal hemorrhages. In one of his own cases it was necessary to enucleate such an eye on account of secondary glaucoma, and the subretinal space was found to be filled with a serum containing a large amount of cholesterine. This finding supports the view that they belong to the Coats' class, as one of the diagnostic points in massive exudate is the presence of cholesterin crystals in the retina.

Dr. Ziegler said that the cases Dr. Friedenwald refers to are similar to those recorded by Eales, in which subretinal hemorrhages were the sequelæ of a vasomotor neurosis engendered by temporary constriction of the bloodvessels of the alimentary and genital tracts. The cases that Dr. Ziegler personally had seen depended more particularly on constipation and errors of diet. In one case, a woman, aged twenty-one years, an inmate of the blind asylum for seven years, suffered attacks of constipation for periods of one to two weeks, following dysentery. She had recurrent hemorrhages in each eye, subretinal in the left, causing detachment, and ciliary in the right, causing cortical cataract. The latter was extracted in 1890 and was followed later by a V-shaped capsulotomy on a dense capsule. An error of diet, eating strawberries, caused recurrence of the hemorrhage. When this cleared up proper refraction gave her normal vision for both distance and near, which has been retained for over thirty years.

Dr. Ziegler said that he had presented before this Section, about fifteen years ago, a group of three or four young females with recurrent hemorrhages caused by chronic constipation. The cases responded to mild but persistent catharsis. One had, in addition, hemophilic extravasation and nasal obstruction which was relieved by intranasal cauterization and the elimination of peaches from her diet. He though that, like all obscure lesions, there are many idiosyncrasies that demanded most careful study.

NOVEMBER 20, 1924

Allergic Reactions in Vernal Conjunctivitis

Dr. Louis Lehrfeld gave the results of experiments on cases of vernal conjunctivitis, with a view of determining the possible reactions to fruits and vegetables common to the spring of the year, and to animal and food products with which children and adults are likely to come in contact. Five patients were subjected to the tests, three corneal and two conjunctival types. In summing up the findings in these cases, the point of striking interest was that in each case there was a reaction to at least one of the proteins used in the sensitization tests. Making due allowance for the personal equation in reading and interpreting the reactions, concerning which there is no definite agreement among laboratory workers, the findings of an allergic reaction even in one patient is significant. Of course, further testing with a greater variety of proteins, and particularly with those of fruits and vegetables common during the spring of the year, would be desirable; but, as Low says: "One cannot test every case to every possible protein, and there is always the possibility that the patient might be temporarily desensitized."

In the three corneal types, blood-fluid from the incised lesions showed a predominance of lymphocytes and in one instance a large number of eosinophiles. The presence of eosinophiles is frequently found in the discharge of vernal conjunctivitis. With these find-

ings, attention was called to their striking similarity with those of cutaneous rashes caused by certain fruits and vegetables, of the urticarias, of eczema in children, angioneurotic edema, of hay-fever and asthma. Asthma is often attended by lymphocytosis and eosinophilia, as are also allergies to certain foods and animal and vegetables products. Dr. J. Alexander Clerk found eosinophilia in about 30 per cent of his cases of asthma. Therefore, may it not be reasonable to regard vernal conjunctivitis as an ophthalmic urticaria, or an allergic or atopic conjunctivitis, because of the local and sometimes general eosinophilia vasomotor disturbance, itching, the pathology and allergic reactions shown?

Dr. William Campbell Posey said that several cases of vernal conjunctivitis under his care had been subjected to these tests, but in only one were the results positive, a lad, aged fourteen years, with a typical type of papebral conjunctivitis complicated with asthma of years' standing. The test showed him to be sensitive to horse dander and mildly so to ragweed, June grass and two other grasses. During the past two years he has received vaccines made from the pollen of these plants and from horse dander. He has been kept away from horses and not allowed to sleep on a hair mattress. No attack of asthma has occurred since the treatment was inaugurated. As the eyes were subjected to radium treatment, it is difficult to say whether the ocular improvement can be attributed to that source or to the vaccines. Dr. Posey said he had followed a number of cases of conjunctival irritation excited by the proximity of horses and by certain kinds of fruits, but none of these possessed the characteristics of typical vernal conjunctivitis.

Dr. Burton Chance thought that Dr. Lehrfeld deserved praise for the industry which he has manifested in carrying on his observations on this group of patients, and he trusted that the patients might be followed up in the spring of next year with the hope that Dr. Lehrfeld's studies toward the solving of the mystery of vernal conjunctivitis might be corroborated.

Dr. Edward A. Shumway reported, in connection with Dr.

Lehrfeld's cases of vernal catarrh and asthma, a case of severe lid involvement with a tendency to asthma that had been successfully treated with radium by Dr. Pancoast. The patient had also shown a marked idiosyncrasy for aspirin, 10 gr. of which would cause alarming edema and bloating of the face and throat, with a rash on the face.

Demonstration of Normal and Abnormal Pupillary Reflexes

Dr. Francis H. Adler said that in order to demonstrate lesions of the pathways for the light reflexes, cats were operated upon, and lesions created in various parts of the arcs. After degeneration had taken place the animals could be utilized by the student for localizing the various lesions.

A Test-chart Screen and a Familiar Test Chart, with Letters Reorientated

Dr. Sidney L. Olsho showed a test-chart screen which has a wooden framework consisting of two parallel vertical and two parallel horizontal pieces suitably intercrossed. Each of the four crosspieces is grooved to form with its fellow on the opposite side a vertical and a horizontal pair of grooves, which support four movable black panels, test-chart size. These are positioned one at each of the four sides of the stationary central test chart. The black panels may be adjusted to any position toward and away from each other within the grooves, in which they yieldingly slide, so that any selected number or group of characters on the test chart, in horizontal or vertical lines, may be disclosed to view, all other characters being at such times concealed. The black panels form a rectangular aperture of any desired size, over any portion of the test chart, which is the familiar Snellen card with the letters rearranged so that they are in a vertical as well as in horizontal lines.

Some of the advantages of this chart are: That the aspect of the

chart is agreeable to the eye; in taking the vision, the patient may be asked to name only the first letters from above downward, until his limit is reached—all other letters may be temporarily concealed by a panel; a refraction may be continued with only a single line of letters visible; useful small sections only need be disclosed to view; the patient's interest is aroused, mainly to secure clear definition; a different and unfamiliar portion of the chart may be readily exposed; applicants visually ineligible for air, army, navy, railroad or pilot service cannot deceive examiners through having memorized the letter sequences; only one, or only two, letters beyond or not yet brought within the patient's range may be kept concealed; nervous or aged patients with low visual acuity may be kept unaware of the presence of small letters indistinguishable to them.

Tobacco Amblyopia—Senile Amblyopia—Ocular Affections from Non-venerial Infections of the Prostate

Dr. George E. de Schweinitz presented three separate subjects for discussion:

1. Certain Contributing Factors in the Development of Tobacco Amblyopia.
2. Senile Changes in the Optic Nerves, the So-called Senile Amblyopia.
3. Certain Ocular Disorders Probably Due to Prostatic and Bladder Infections of a Non-venereal Origin.

1. *Concerning Certain Contributing Factors in the Development of Tobacco Amblyopia:* Dr. de Schweinitz briefly referred to disturbances of metabolism, gastrointestinal sepsis and toxemia derived from areas of focal infections as contributing factors in the development of tobacco amblyopia, and to the earlier and later literature on this subject (observations, for instance, of Horner, Sachs, Edsall and himself), and reported some clinical histories of tobacco amblyopia in elderly subjects (sixty and more years of age), who had smoked, sometimes moderately, for forty years or more with impunity, without changing their habits or the quality

or quantity of the tobacco, but whose eye-grounds exhibited in moderate degree the so-called senile retinal angiosclerosis (reduction of the apparent caliber of the veins and arteries, their lumina remaining regular; no venous compression, no hemorrhages or exudations, the disks being temporally pallid, and slight sclerosis of the choroidal vessels being visible) who acquired after this long period of immunity the characteristic papillomacular scotomas. Although he recognized the influence of the so-called cumulative effect of tobacco as a possible explanation, he regarded it as an unsatisfactory one, and expressed the belief that sclerosis of the small optic nerve and retinal nutrient vessels should be regarded as the contributing factor. He compared the effect of such vessel changes on the resisting power of the nerve tracts involved to that exercised by metabolic and other toxins in this respect, as had been described at the beginning of his paper. He described the distinctive feature of the tobacco scotoma and referred especially to the work of Traquair, Doyne, Sattler and to some recent observations of his own.

2. *A Clinical Note on Senile Changes in the Optic Nerves—the So-called Senile Amblyopia.* After a brief reference to the literature of this subject and some allied conditions, Dr. de Schweinitz referred to Uhthoff's recent description of acute neuritis due to cerebral arteriosclerosis, rapid in onset and prompt in subsidence, with a resulting optic nerve atrophy and shrunken retinal vessels; to central scotomas occurring in the subjects of arteriosclerosis; and especially to a type observed in elderly persons, characterized by atrophic pallor of the optic nerve, without shrinking, sometimes associated with a relative scotoma of low intensity, with senile retinal arteriosclerosis, as before described, and only moderate reduction of visual acuteness and depression of the peripheral field.

Such cases, especially in their slighter manifestations, he thought were similar to those recently reported by Salzer, of Munich, and when first noted they did not ophthalmoscopically depart far from normal appearance.

Often mistaken for progressive atrophies from other causes, the

optic nerve pallor increased, but a definite atrophy of the fibers did not take place or developed only with notable slowness.

He discussed briefly E. Fuch's pathological investigations, especially those which had revealed arteriosclerosis of the small vessels in the optic nerve, and the presence of amyloid bodies which took their origin in the neuroglia and pressed upon the nerve fibers, or separated them, and also Salzer's suggestion that small, invisible hemorrhages might be responsible etiologic agents. He believed, in spite of the fact that the condition was well known, that this so-called senile optic nerve atrophy, or atrophic pallor, was not infrequently unrecognized as to the true causative factor, being attributed to conditions which were not operative.

3. *Some Remarks on Certain Ocular Disorders Probably Due to Prostatic and Bladder Infections of a Non-venereal Origin.* After referring to Swineburne's statement that non-venereal infections of the prostate were destined to be regarded as almost as common as chronic tonsillitis, Dr. de Schweinitz discussed briefly a special form of keratitis due to colon-bacillus infection of the bladder and prostate (also the intestines), as it had been described by Lawson, Browning and McLeish. Although no examples of keratitis exactly corresponding to this type had been encountered in personal experience, he had seen cases, which were quoted briefly, where a non-venereal prostatitis had apparently been in part, if not entirely, responsible for a keratitis which clinically suggested a neuropathic type, and to form interstitial corneal infiltration, associated with or following iridocyclitis, streptococci and staphylococci being the offending organisms. These, as he had noted them, had been of long duration, had been subject to many exacerbations, and had resisted the usual remedies, but had been markedly relieved, and in one instance entirely cured, by elimination of the prostatic infection (massage, etc.) and autogenous vaccine therapy.

He also described in general terms various types of so-called senile macular retinochoroiditis which had been similarly favorably influenced in the sense of a cessation of crops of small hemorrhages, although in no instance did degenerated areas resume function

or pigment spots, etc., disappear. He referred to the very early stages of senile macular retinochoroiditis, or to that period when ophthalmoscopic changes were vague and visual acuteness was not notably depreciated, but when metamorphopsia and relative blue scotomas indicated the beginning of future grave events, as the period when the elimination of focal infection in the prostate or bladder was important, or, indeed, its elimination from any of the other well-known areas, notably the teeth, and even the edentate gums of elderly subjects, as in the sites of past extractions of diseased teeth there may be underlying granulomata and cysts which contain the same bacteria which were present in the abscessed teeth.

The prostatic condition of all of his cases had been studied by Dr. Alexander Randall, and the general examination had been made by Dr. O. H. Perry Pepper.

Dr. de Schweinitz recognized that his cases were too few in number to permit more than suggestions, and also recognized that the effect, or apparent effect, of autogenous vaccine therapy might be ascribed to an influence similar to that created by the intravenous injection of foreign proteins, and that it was not specific. But he thought the subject worth further investigation, especially in very early stages of senile macular retinochoroiditis, in the hope of ascertaining methods of treatment which might possibly check the progress of this intractable infection, and in spite of the fact that it was extremely difficult to determine the evaluation of medicinal agents, especially vaccine therapy. To some of these observations he had referred in a recent lecture before the Société Française d'Ophtalmologie, but as the paper had not yet appeared in print, he had ventured to incorporate them in the present essay, as abstracted above.

Dr. William Zentmayer stated that, in 1901, in reporting 3 cases of so-called tobacco-alcohol amblyopia, he felt that this was a manifestation of arteriosclerosis and that arteriosclerosis is probably a contributing factor in the production of the amblyopia. When one considers the relative infrequency of tobacco-alcohol amblyopia, stated by Weeks as occurring but four times in 10,000

private patients, contrasted with the almost universal use of tobacco, it would seem as though there must be some individual predisposition.

In consulting the literature more recently he found that Scalinci and Kruger also believed that the arteriosclerosis which they found present in their patients was not to be attributed to the toxic agent, but that it was an independent condition and an important factor in the causation of the amblyopia.

In view, then, of the relative infrequency of eye symptoms among habitual users of tobacco and alcohol, of their comparatively late appearance in life, of the marked difference in degree of impairment of vision of the two eyes, of the presence of a low-grade retinal arteriosclerosis in many of the patients, and of the not infrequent appearance of retinal hemorrhages, it would seem to him that a causal relation between arteriosclerosis and tobacco-alcohol amblyopia is probable.

Dr. Zentmayer said also that, in the past two years, he had seen at least three cases of uveitis which were probably due to infection from the prostatic gland. One was in a man about fifty years of age who had lost the vision in the right eye through repeated attacks. When first seen by him he was suffering from an acute recurrence and the vision in the other eye was reduced to 2/60. He was placed in the hospital and under energetic treatment the vision in about five days was brought back to 5/30. An urologist was then asked to see him and in the course of his examination massaged the prostate. Some hours later there was a violent exacerbation of his symptoms as a result of which the vision was reduced to light perception. He ultimately made a good functional recovery, but there remained serious sequellæ.

Another case was in a man also of about fifty years of age, who in the course of a treatment for prostatic inflammation, including irrigation and massage, developed an iritis. The urologist felt himself competent to treat the eye condition and ordered atropine. The result was that many posterior synechiæ formed, producing excruciating pain which demanded attention. He cautioned the urologist against massaging the prostate, but nevertheless after

the eye had been quiet for several days he evidently considered it safe to return to this procedure. As a consequence there was a severe relapse. While this may have been a coincidence, these observations are in line with what we have all seen after the extraction of an infected tooth or the liberation of pus into the system following other operations.

Dr. Edward A. Shumway cited a patient who had suffered with repeated attacks of keratoiritis of a dendritic type, in which the most likely focal cause seemed to be in the prostate, as he had had joint involvement and a history of gleet. Massage of the prostate showed a discharge, but no gonococci. Autogenous vaccines made from the organisms present, and also injections of gonococcus bacteria, failed to effect a cure, and the attacks continued—a warning that all possible foci should be eradicated in dealing with an ocular inflammation in which eyesight was threatened.

He said also that he had treated several remarkable cases of superficial retinitis in young, healthy students, in which a rapid spread of the process made the prognosis gloomy. In both instances tonsil infection was the sole cause found, and their removal was followed by prompt subsidence of the process and return to normal vision; a further lesson that such cases should be actively treated after thorough examination from all angles, and no case considered hopeless until it had been adequately treated.

Dr. H. Maxwell Langdon stated that at the American Ophthalmological Society meeting last June, Dr. Feingold presented a series of cases of central retinal changes in elderly people. Dr. Langdon also reported a case, in which there were macular exudation and recurrent hemorrhages, and, except for a moderate arteriosclerosis, no definite cause could be found. The right eye became slightly involved, and then as an empiric measure high intestinal lavage was instituted with apparent complete checking of the course of affection in the right eye, with improvement of vision of the left eye. He mentioned this, as it seemed well to bear in mind that the intestinal tract may be the site of the infection which

is causing the ocular disturbance as well as those foci which are more commonly thought of.

Dr. de Schweinitz, closing the discussion, said that Dr. Zentmayer's observations on the association of retinal hemorrhages and tobacco amblyopia, which he had reported years ago, and to which, since then, other investigations had been contributed, were important additional evidence that arteriosclerosis may be a contributing factor in the development of this type of visual defect, although the manifestations were of a character different from those which had been emphasized in the paper.

It was well known that massage of the prostate was sometimes followed by an exacerbation of a focal inflammation, exactly as a removal of an abscessed tooth or a septic tonsil might be and often was responsible for a fresh outburst, for instance, of an iridocyclitis. Indeed, this very experience was regarded by some observers as an indication that the responsible focal infection had been uncovered.

Dr. Langdon did well to remind the Section that the intestinal tract was an important area from which septic products proceed and produce metastatic ocular inflammations, but Dr. de Schweinitz hardly thought this source was being neglected. Dr. Langdon's point, however, was well taken in that even where the intestines had been thoroughly examined and submitted to various irrigation and other processes, certain pockets of septic material might be missed, which, indeed, might well be the most important factor.

He again emphasized the possible value of eliminating focal infections, notably those in the prostate and bladder, in the management of the early stages of so-called senile macular retinochoroiditis, but he fully recognized the difficulty of satisfactorily proving the relationship to which he had referred.

Demonstration of Sets of Pictures for Use with the Camerascope. Demonstration of a Large Bifocal Operating Glass

Dr. Edward A. Shumway showed completed sets of pictures for use with the "camerascope," a simple stereoscope for fusion

training. These were three in number, the first a series of colored sketches to develop simultaneous vision and later fusion; and two sets of photographs, mostly of animals, all of the pictures having been chosen to hold the interest of the children.

Dr. Shumway demonstrated also a large bifocal operating glass. The bifocal addition was sph. + 4 D. and was 20 mm. high, reaching the optical center of the 40 mm. round lens. The combination gave a large field, with plenty of magnification for cataract operations, etc., and yet gave plenty of room for distant vision above. Dr. Shumway explained the method of cutting the glass from the original ultex blank, and said the usual width of the bifocal disk was 32 mm. The vertical height could be made still greater and such a lens, from 24 to 26 mm. high, extending above the optical center of the distance portion, could be of great use to a musician, such as a pianist, who needed to see clearly, also at a distance, in accompanying a singer; an organist in directing a choir; or an artist painting from a model or a landscape. Dr. Shumway also showed the lenses, with a central bifocal disk, which could be used by nose and throat men in connection with the head mirror.

Dr. H. Maxwell Langdon said it might be of interest to mention the new one-piece trifocal glass in which the distance and near segments are separated by an intermediate strength, about 5 mm. wide, that is ground only sph. + 1.37 stronger than the distance glass. At present this is the only intermediate addition which can be obtained. Inasmuch as it is not until a person requires an addition of a + 2 or more for near work that the intermediate strength becomes of great advantage, this is a fairly satisfactory combination.

Dr. William Zentmayer said that, in considering this subject of lens helps, he had found great assistance in using the Zeiss binocular loup, which fits so closely to the eye that it is impossible to wear glasses when it is being employed, and to have his refraction correction permanently behind the convex lens of the instrument. If one has a high astigmatism the visual acuity is cut down considerably unless one has the correction mounted in the loup.

Dr. Frederick Krauss stated that in the use of the head mirror for throat and nose work he had found it best to have the added correction placed in a cell with a broad base, which is then attached to the metal back of the head mirror. In this way the correction is always in place and the need of an extra pair of glasses obviated.

Dr. Mary Buchanan showed a pair of spectacles made by Mr. Alfred Bender, consisting of cemented bifocals sph. + 5, combined with 5 degrees prism base in, on the distant correction. These are useful in removing minute foreign bodies from the cornea and in the discission of capsular cataract; as they permit good distant vision, they are better than a binocular loup.

As an improvement, Mr. William Wall produced a pair of small, 30 x 20 mm. near lenses, incorporating the sph. + 5 combined with 5 degrees prism in an eye-glass mounting. The glass is dropped so low that the upper border corresponds to that of an ordinary bifocal. The eye-glass mounting is so small that it can be carried conveniently.

In closing, Dr. Shumway said that Dr. Krauss's plan of having a presbyopic lens in front of the opening in the head mirror was satisfactory in looking into the ear or nose, where only one eye could be used, but in mouth and throat examination a better stereoscopic view would be obtained if both eyes were corrected by the bull's-eye glass.

Embolus of the Central Retinal Artery: Recovery of Vision Under Galvanism

Dr. S. Lewis Ziegler presented a patient, aged seventy years, to show the end-result of embolus of the central retinal artery treated by galvanism for about nine months, the vision having been restored to what is practically normal. The same case was mentioned in the discussion at the February meeting as starting with a vision of 1/200, eccentric, in October, 1923, and progressing to 20/70, in January, 1924, under positive galvanism. As soon as the clot was absorbed and the disk showed pallor the current was reversed to the negative pole in order to stimulate the func-

tion of the nerve. It was interesting to watch the "pinking" or vascularization of the nerve head, and to note the rapid improvement as soon as the line of vision had passed the center. Bulbar massage was instituted for the first month. A large central scotoma was observed in the first field, but this soon disappeared. At the time the patient was discharged, in June, 1924, the vision was 20/20 pt., and J–1 pt., with fields widened to 50, 40 and 30 degrees. This has held steady ever since. An effort will now be made to increase the fields of vision. The results gained in this and similar cases should demonstrate the unwisdom of uttering a "hopeless prognosis" in cases of embolus.

DECEMBER 18

Traumatic Rupture of Choroid

Dr. Leighton F. Appleman presented a boy, aged ten years, with triple rupture of the choroid on the temporal side of the disk, which followed a blow over the right eye two months previously with a piece of iron 2 x 2 x ½ inches. There had been a cut of the lower lid below the inner canthus and of the skin of the brow. The eyeball showed no external evidence of injury, but the pupil was widely dilated and fixed, V. =6/60. The largest rupture was situated midway between the disk and macula, extending vertically about the length of two disks diameters, widest at the upper extremity with an irregular outline, and tapering toward its lower extremity, with sharper outlines fringed with pigment; the second was crescentic in shape, parallel with the first, and almost exactly through the macula, about 1.5 disks diameters in length, and the third one disk diameter to the temporal side of the macula, and slightly shorter than the others, crescentic and with a narrow fringe of pigment. The disk was normal, as were the remaining portions of the eye-ground.

The Kuhnt-Heisrath Operation for Trachoma

Dr. William Zentmayer presented a case of trachoma upon which a Kuhnt-Heisrath operation had been done, because it was thought that the value of this procedure is not fully appreciated.

The patient was in the hospital for eight weeks previously, with routine local treatment, but showed little improvement when discharged. A severe exacerbation and pannus resulted and vision was reduced approximately to l. p. in each eye. One week after the operation was performed the patient was able to tell time on a watch, and the pannus had largely disappeared, although there were still superficial ulcers.

Clinical Cases with Slitlamp Studies

Dr. Luther C. Peter gave the details of 4 cases studied with the slitlamp. The first case was one of traumatic vitreous hernia in a man, thirty-four years of age, who was struck on the left eye by a nail some weeks ago, V.R.E., 6/6; L.E., 6/9 partly. The ophthamoscope showed fine dustlike particles in the pupillary area; a hazy lens; a break in the sphincter muscle down and in; media otherwise clear and fundus normal. The corneal microscope showed the iris sphincter ruptured down and in, and the lens hazy in its lower inner quadrant, the opacities being mostly capsular. There was no appreciable dislocation of the lens. A tongue-like protrusion of the vitreous appeared at the inner half of the pupil, sharply outlined, and later covered the entire pupillary space and extended well to the temporal side. After contraction of the pupil by eserine, the hernia diminished in size and became limited to the pupillary space. Tension from 2 to 13 mm. higher than in the right eye, although not above 25 mm. A point of much interest is how it was possible for the vitreous to break through the zonular fibers, through the canal of Petit between the lens and iris, without an appreciable dislocation of the lens.

The second case was a vitreous hernia in a man, sixty-nine years of age, following a spontaneous rupture of the anterior lens cap-

sule, dislocation of the lens nucleus into the anterior chamber and secondary glaucoma. For eight months the tension varied from 20 to 40 mm. Hg. With micro-arc lamp illumination, the corneal microscope showed edema of the posterior surface of the cornea, the remnants of a dislocated lens nucleus in the anterior chamber, and an iris which was markedly atrophic. The pupillary space was occupied by a fibrous capsular cataract adherent to the iris, and, protruding through the rent in the capsule below, a vitreous hernia spread over the entire lower half of the anterior chamber well into the angle. This was studded with myriads of red dustlike particles. The eye was enucleated because of the pain.

The third case was one of bilateral senile cataract and bilateral primary glaucoma. The patient, sixty-five years of age, was operated on for cataract by a confrére eight years ago, and has gradually lost his vision in both eyes with the exception now of the lower outer quadrants. Tension, R.E. 26 mm.; L.E. 43 mm. Because of the rapid falling-off of vision and the increased tension, cyclodyalisis was practised in each eye. Slitlamp studies before operation revealed, in the right eye, peculiar formation of after-cataract, which consisted in clusters of globules attached to one another with small pedicles, the globules being filled with fluid, transparent and in almost constant motion. After cyclodyalisis, these clusters of globules were somewhat broken up and covered with a more or less semi-transparent membrane. Two months after the cyclodyalisis, the slitlamp revealed a shallowing of the chamber in the area of the detachment of the ciliary bodies.

Elschnig, in 1911, reported 5 cases of this type of after-cataract, and thought the globule-like formations were due to activity of the epithelium. Another point of interest is evidence that the ciliary body has become reattached to the sclera at so early a date, thus probably indicating one of the reasons for the failure to obtain permanent results after cyclodyalisis.

The fourth case was one in whom was shown an opacity which surrounds the inner quadrant of the peripheral embryonic nuclear zone of the lens. The corneal microscope clearly defines the

anterior and posterior layers of the opacity with reference to the anterior and posterior nuclear Y's. The interest in this case centers in the ease with which the corneal microscope localizes the particular zone which the opacity occupies, and the ability to determine, with a fair degree of accuracy, the time when the opacity was formed. As this opacity is strictly limited to a particular part of the lens which was formed during intrauterine life, before the more peripheral layers of the lens were laid down, it is probable that this cataract had its origin before or shortly after birth.

Exhibition of a Case of Pseudoneuritis and a Squint Case Operated on by the Recession Method

Dr. Warren S. Reese presented a case of pseudoneuritis exhibiting marked blurring of the disk margins resembling a true neuritis, especially in the left eye, the latter showing slight elevation of the disk. This man was a neurotic Italian who did not speak English, so that satisfactory perimetric and other examinations were impossible. Retinoscopy showed that he had three diopters of hyperopia in each eye, with V.R.E. = 6/21.

Dr. Reese also exhibited a patient who had been operated upon for a convergent squint of 28 degrees by a recession of the internus of the left, or squinting, eye, which was amblyopic. At the end of ten days there was still a residual squint of 13 degrees in the primary position. A rather peculiar condition existed in that on looking up the visual axes were parallel, but as the eyes were carried down they became more and more convergent. He hoped to correct the remaining squint by an advancement of the antagonistic externus and the placing of the sutures so that the line of action of this muscle would be below the horizontal plane and thus help correct the convergence that exists on depression.

Dr. Luther C. Peter said that the convergence in the lower field of the squint case exhibited by Dr. Reese was probably due to

force of habit, the converging center still remaining active. As convergence is naturally accomplished in the lower field, it becomes an automatic action on the part of patients when they fix upon an object near at hand in the lower field.

Dr. William Zentmayer said that Dr. Reese's case was an unusually well-marked one of the type of spurious optic neuritis known as pseudoneuritis striata. The importance of these cases is the differential diagnosis from true papillitis. It rests largely on the absence of distention and tortuosity of the veins and absence of retinal hemorrhages, normal field limits and persistence without alteration in its appearance.

Dr. H. Maxwell Langdon referred to a boy, aged twelve years, whom he saw some years ago, with hyperemia of both disks, obscuration of the margins and elevation of the disk level 1.5 D. The vision was normal, there was no hemorrhage, the fields were normal for form and color and the muscle balance unimpaired. Examination by an internist and neurologist showed no abnormalities.

Dr. de Schweinitz saw the boy in consultation, after he had been under observation for several months without change, and agreed that it was in all probability a pseudopapilledema accompanying a moderate hyperopia which he had of 1.5 D. Although he said had he not been under observation for such a long time he would have made a diagnosis of true papillitis from the appearance of the disks alone. No changes were observed for the ensuing two years, during which time the boy was occasionally seen. So far as he knew, he had not developed since any general condition which would make this a true papillitis.

Visual Field Studies in a Case of Optic Neuritis Secondary to Sinus Disease

Dr. J. M. Griscom and Dr. M. Monroe reported the details of a case of the optic neuritis caused by suppurative ethmoiditis,

in which a series of visual fields had been taken over a period of nine months. The fields showed increased contraction for color and the presence of a paracentral scotoma with enlargement of the blind spot. The point of main interest concerning these studies was the fact that the progress of the disease toward recovery with two distinct periods of exacerbation was indicated only by the variation in the color fields and the enlargement of the blind spot. It was suggested that probably in most optic-nerve affections secondary to sinus disease carefully taken fields will serve as the best and perhaps only guide as to the progress of the disease and so enable the ophthalmologist and rhinologist to take a middle course between necessary radical procedures, on one hand, and too long delayed operations on the other.

New Bloodvessel Formation in Vitreous

Dr. Hunter W. Scarlett presented a man, aged twenty-six years, with a projection of new bloodvessel formation into the vitreous of the left eye. There was slightly reduced vision in the eye. The mass of vessels proceeded branchlike from the temporal edges and side of the disk, and extended into the vitreous about three diopters. These gave off smaller branches, which ended in small round convolutions. No supporting fibrous framework could be detected. There was some slight pigment disturbance at the site of origin of these vessels.

PROCEEDINGS

OF THE

SECTION ON OTOLOGY AND LARYNGOLOGY

JANUARY 16 .

Report of Two Cases of Vertigo Due to Diseased Tonsils

BY A. W. WATSON, M.D.

The association of dizziness with systemic poisoning from a focus of infection is well recognized, and as a result of diseased tonsils has been noted. We know that all vertigo is caused by irritation of the internal ear, either by disease of the ear itself or by influences from without. I have considered these two cases of sufficient interest to report here because, on account of the association of the vertigo with chronic ear disease, they suggested serious involvement of the internal ear or brain, and because a labyrinth test was made in both cases:

Case I.—Mr. W., aged thirty years, business man, came to me first in April, 1915, on account of increasing deafness, which he had for about five years. There was no history of nasal or throat trouble. General health good.

Examination. Slight deviation of septum to right, some turgescence of turbinates, no obstruction. Pharynx follicular, tonsils moderate in size and not apparently diseased.

Right Ear. Drum membrane dull; hears watch at 8 inches; acoumeter at 4 feet; low voice 8 feet; Rinné negative; bone conduction prolonged.

Left Ear. Membrane dull; hears watch at 20 inches; acoumeter 6 feet; loud whisper at 8 feet; Rinné negative; bone conduction prolonged. A case of chronic middle-ear catarrh.

Some improvement followed treatment, which was kept up at irregular intervals (the patient came from another city) for about six months.

In December, 1920, he returned, complaining of dizziness, tinnitus and nausea. The hearing had diminished considerably. By January, 1921, the vertigo had become more severe, the attacks coming on while at his buisness, and so bad that he could not walk across the room without holding on to something. On one occasion there was vomiting, and some days he was compelled to stay in bed.

I now asked Dr. Lewis Fisher to make a labyrinth test, which he did, and sent me the following report:

January 15, 1921. "Both cochleæ are hardly impaired at all. The deafness in his case would appear to be largely of the catarrhal type, and although bone conduction is perhaps not quite as long as one would expect in a case of catarrhal deafness as marked as his, yet the high tones are heard quite well, and, I believe, it is best to regard the cochleæ as practically unaffected.

"The vertical semicircular canals on both sides show hardly any responses at all, and while douching them produces no nystagmus or vertigo, it makes the patient nauseated and quite seasick. That would suggest that there is nothing wrong with the canals themselves, but that the trouble is probably central. The entire picture in this case, from a vestibular standpoint, is one of some central disturbance. However, on this examination there was nothing to suggest an organic mass-lesion at any one point. He may be in the very earliest stages of such a lesion, or it may be due to some virulent toxin affecting the vestibular mechanism. A blood examination in search for a possible syphilitic infection would be advisable. As a mere suggestion, it might be well to consider ridding him of what appear to be infected tonsils. Should they perchance act as the source of the toxemia, it would furnish an easy solution of his difficulties."

A Wassermann test was made, which proved negative. On February 18, 1921, the tonsils were removed. At the operation the tonsils did not show gross signs of disease, but from that time up to March, 1922, the last time the patient was seen, there had been no return of the vertigo.

Case II.—Miss F., aged fifty-two years, teacher, was first seen September 15, 1915. The history was: Attacks of nausea and staggering for two years. Very frequent of late. Also deafness and tinnitus in the right ear. There was a history of rheumatism, for which her teeth had been extracted, with relief of the rheumatism. There were no nose or throat symptoms and no history of any trouble in those parts.

Examination. Nose negative.

Right Ear. Hears acoumeter at 3 inches; Rinné negative.

Left Ear. Practically normal. Throat negative.

Treatment of the right ear seemed to relieve the dizziness. However, she continued to have recurrences at irregular intervals. In 1920 and 1921 the attacks were more frequent. In February, 1922, she appeared with a black eye and the statement that the day before, while walking home from school, she had been suddenly taken with vertigo and had fallen, striking her head on the edge of a door-step.

Having had the experience of the first case, I now examined the tonsils more carefully. Both were very small and flat and entirely buried in the palate, so much so that the anterior pillars had to be retracted in order to see them at all. Both tonsils were found to be diseased, especially the left, from which a pus-like fluid could be expressed.

Dr. Fisher having examined the first case, and being interested in the condition, when he heard of this case asked to examine it. His report is as follows:

"February 8, 1922. Right Ear: Cochlea almost completely destroyed. With the noise apparatus in the other ear, shouting is heard, but scarcely understood.

"Vertical semicircular canals produce a slight nystagmus after

douching. The response, however, is very poor. There is no past-pointing.

"Horizontal semicircular canal produces a small eye response and no past-pointing.

"Left ear: Cochlea normal.

"Vertical semicircular canals produce no response whatever.

"Horizontal semicircular canal produces fair response both for nystagmus and past-pointing.

"There is present a spontaneous vertical nystagmus upward. This is not always present, but can be elicited by having the patient look as high up as possible for a few seconds, when it will suddenly appear.

"The case is not by any means typical of either peripheral or central lesion. It is difficult to explain how a peripheral lesion will produce the vertical spontaneous nystagmus or the impairment of the vestibular portion of the left ear—the ear with the good hearing. If a toxemia is responsible for the entire picture, why should the left cochlea escape? On the other hand, if we are to explain the picture on the basis of a central lesion, we must assume such a lesion to be situated in the right cerebellopontile angle. There are many things that do not quite fit in with that, such as the presence of some response from the vestibular portion of the right or deaf ear (this should by this time be all abolished in such a lesion). There is still another thing against it, and that is the response obtained on stimulating the horizontal semicircular canal of the left ear (the hearing ear), which is not quite as good as it ought to be. In other words, we lack the complete evidence of a perfectly normal left ear in its entirety. Taking it all in all, however, I would rather be inclined to assume that it is an atypical central lesion rather than to consider it a peripheral lesion, because the presence of a spontaneous vestibular nystagmus is most significant. In view of the uncertainty of the diagnosis, I would suggest that the removal of the diseased tonsils is the proper thing to do, with the thought, however, that the patient be watched and reëxamined from time to time for the possible appearance of additional signs of intracranial lesion."

February 9, 1922, I removed the tonsils, under local anesthesia. The dizziness continued at intervals in a mild form for a few weeks, but after that disappeared entirely. I saw the patient off and on during the following year and a half and she remained free from vertigo.

In June, 1922, Dr. Fisher made another examination of the patient, and sent me this report:

"The reëxamination of the ear in the case of Miss F. shows a remarkable change in the vestibular findings as compared to those at the time of the original examination. Many of the responses, which were completely absent, appear to come through fairly well. In other words, there probably has occurred some recovery since the tonsil operation."

I have quoted these reports of the labyrinth tests thus fully, as they seemed to me most interesting in relation to this subject.

Report of a Case of Nasal Fibroma

BY BENJAMIN D. PARISH, M.D., AND GEORGE E. PFAHLER, M.D.

Nasopharyngeal fibromas are unique in that they are benign tumors, in the pathologico-anatomic sense, but their course is malignant because of rapid growth. The rare occurrence of nasal fibroma is demonstrated by the fact that at the Basel Clinic only 11 cases have been observed in twenty-six years. They nearly always have an intrapharyngeal attachment, and in all cases recurrences ensued one or more months after operative treatment. The literature also shows that under operative treatment one or more recurrences generally preceded complete permanent cure, and that in nearly all the cases cited, unusually profuse hemorrhages occurred. These tumors are distinctly most prevalent during adolescence, and after the age of twenty-five years spontaneous regression generally occurs.

This report is of a boy, S. F., aged fourteen years, who was referred to me for examination on June 8, 1921, because of certain symptoms of nasal obstruction, and with the statement that he always seemed to have a cold in the head. His previous history was that he had had measles, chicken-pox, whooping-cough, and that his appendix had been removed. Also his adenoids had been removed in 1917. With the postnasal mirror a large, smooth, rounded mass could be seen extending well to the posterior pharyngeal wall and obstructing any view of the right Eustachian tube. Anterior rhinoscopy showed a pinkish-white mass pressing against the septum in the right nostril and extending almost to the floor of the nose and completely hiding the middle turbinate and ethmoidal region. The septum was rapidly being pushed toward the left and symptoms referable to pressure upon the Eustachian tube were beginning to manifest themselves. There was considerable bleeding on probing and the region within the nares showed areas of necrosis.

A small area of growth was snared off and examined by Dr. Case, and the report of an angiomatous fibroma, benign, was made.

The patient was admitted to St. Agnes Hospital on June 20 for operation.

Having in mind the angiomatous structure, after consulting with Dr. George Dorrance, it was considered advisable to have the latter ligate both external carotids before attempting removal of the growth.

The question of the best way to approach the growth was considered, and it was very desirous not to make any external scar or large deformity, usually resulting from a Moure operation or other external method. It was hoped that the growth had a pedunculated base, though it was impossible to determine this from examination except under ether.

The anesthetic was ether and the growth attacked postnasally with a snare and anteriorly with Luc and Breuning forceps, when sufficient amount of tissue had been removed; with a long periosteal elevator an endeavor was made to separate the base, which was

found to be very broad and attached to the vault of the pharynx and anterior sphenoidal wall. The total amount of growth removed was about equal to a good-sized egg.

The ligation of the carotids above the super thyroids rendered almost bloodless the field of operation. The patient left the hospital ten days after admission. I considered I had removed all accessible tumor tissue possible, but in view of the usual history of recurrence the patient was asked to return for examination after his summer vacation. Three months after the removal of the growth examination showed a mass again encroaching upon the ethmoidal region, but not extending back into the pharynx.

The case was referred to Dr. Pfahler for his opinion as to the advisability of using radiation.

Plates were first taken which showed dense shadows extending into the ethmoids and also into the right antrum. The *x*-rays prior to operation, taken at St. Agnes Hospital, showed no involvement of the antrum or ethmoids.

On September 16 three radium needles, containing 30 mg., were inserted into the tumor and left for six hours. From this date radiation and *x*-ray treatments were given once each week up to December 5. This made a total of 3260 mg. hours applied at a distance varying from 2 mm. to 2 cm., according to the location of the application. In addition to this, he had *x*-ray treatment applied over the anterior surface of the left side of the face November 28, 1921, using 9-inch spark gap, 5 milliampères, 20 minutes' time, 6 mm. filter, at the distance of 30 cm. A similar dose was applied December 5, 1921, in the right submaxillary region and again on January 21, 1922, in the right submaxillary region, and January 21, 1922, in the left submaxillary region.

On November 14, two months after radiation had been started, Dr. Pfahler reported that the right maxillary sinus was entirely clear, though there still was some increased density in the right anterior ethmoid cells. Elsewhere the growth seemed to have been removed and that it was entirely possible that even this density in the right anterior ethmoid cells might be due to fibrous tissue,

but he believed that for the time being it had better be considered as a part of the disease. My examination at that time showed a much increased open area within the right nostril and the area of recurrence greatly diminished, very much more firm and giving greater resistance to probing.

During the month of March, 1922, while at boarding school, away from the city, he had a marked case of facial erysipelas.

In April, 1922, I could discover no visible evidence of the tumor, though Dr. Pfahler reported that the plates still showed an excess of fibrous tissue in the right ethmoid region, but would not recommend any further treatment unless there was some evidence of redevelopment of the growth. On the next examination, May 1, 1922, the entire mucous membrane had become dry and atrophic on the right side and the septal quadrilateral cartilage had necrosed and been absorbed. Whether the original pressure from the growth, the attack of erysipelas or the radium was the cause for this loss of the septum it is difficult to definitely state. My last examination in the fall of 1923 showed no evidence of any return of the growth. The nasal mucosa was secreting much better and the crusting was much less and the boy in excellent health.

Quoting from M. Güssow, on the "Genesis of the Nasopharyngeal Fibromas," *Ztschr. f. Ohrenheilk.*, etc., lxxxii, 103, Wiesbaden, March, 1922: "It is a striking fact that nasal fibromas occur almost exclusively in males. No satisfactory explanation has so far been advanced for this. The theory of Bensch is that the growth of the bony skeleton of the skull comes earlier to a standstill in woman than in man. Another puzzling feature is the occurrence of the tumors between the ages of ten and twenty-five. All explanations of this peculiarity revolve around the assumption of an abnormality in the course of the development of the skull. Their origin is believed by Virchow to be cell-collections dating from fetal life.

"There is still a wide divergence of opinion in regard to the place where these tumors originate. The original site has not been

microscopically examined in any of the cases so far published. There is, however, a specimen at the Breslau Clinic which solves this problem of their source. The sphenoöccipital synchondrosis is seen in the center of the specimen to be composed of normal cartilage cells and sharply walled-off from the tumor lying beneath it, to which it bears no relation. This disproves Gegenbauer's theory, according to which the starting-point of the development of the nasopharyngeal fibroma is in relation with a process of ossification of the synchondroses. The real point of origin is quite patent. It starts from the basilar fibrocartilage, the cartilaginous connective-tissue capsule which covers the under surface of the occipital bone, the foramen lacerum anterius and the fissure petro-occipitalis at the point of junction of the three pairs of bands coming each from the region of the atlas, from the fissura petro-occipitalis and from the region of the pterygopalatine fossa."

Coenen, on the "Genesis of Basal Fibroid," in the *Arch. f. klin. Chir.*, Berlin, 1922, cxxi, 197, states that: "The pedicle of the tumor lies in the middle part of the base of the skull from the ethmoid to the great occipital foramen and laterally to the foramen lacerum anticum and to the pterygopalatine fossa. A choanal, a pterygomaxillary and a tubal type can be differentiated.

In an article on "Nasopharyngeal Fibromas," Pierre Sebileau, *Ann. d. mal. de l'oreille, du larynx*, etc., Paris, 1923, xlii, 553, states that: "Exenteration of these bleeding fibromas should not be undertaken until two points have been considered: (1) The establishment of a way of approach, and (2) provision for conservative measures, such as continuous anesthesia at a distance; thorough tamponment of the propharynx; the employment of measures to maintain the patency of the air passages. Exenteration by torsion is preferred whenever practicable; the trans-nasofacial route is the alternative." Total resection of the superior maxilla constitutes, in the opinion of the author, a surgical monstrosity.

S. J. Crowe and John W. Baylor, *Arch Surg.*, 1923, vi, 429, report on "Benign and Malignant Growths of the Nasopharynx

and Their Treatment with Radium" as follows: "There is an extensive literature on the subject of nasal and nasopharyngeal growths, but very little has been written in regard to their treatment with radium. Radium as a therapeutic agent is far more dangerous than the roentgen ray." The authors report 49 cases at length, giving age, sex, duration of symptoms, clinical findings, treatment and the end-result.

One outstanding result of radium treatment is the high percentage of cures in vascular tumors; although they do not disappear after irradiation so rapidly as some other types, the end-result is much better.

In an article by Studer and Schweiz, at Basel, May 25, 1922, the authors urged that in every case of nasopharyngeal fibroma, radium and roentgen radiation should first be tried. If these fail, operative methods are indicated, especially the technic of Denker or Killian.

Summarizing, the outstanding points of interest to my mind in this case are: (1) The almost bloodless operative field after ligations of both external carotids; (2) no disagreeable symptoms arising after ligation; (3) the gratifying result obtained after Dr. Pfahler's treatment with radium and the *x*-ray.

An Atypical Case of Tuberculosis of the Larynx

BY W. R. WATSON, M.D.

I REGRET that I have not written a paper on this case that I brought here tonight. I understood that the procedure was different. I saw this case first at the Episcopal Hospital, in the ward, and as a consultant, but more or less casually. I was told by the interne that he had had several negative sputum reports, and also a negative Wassermann, and I obtained the information from the patient himself that he had had no pain; that is, he was not suffering any pain at that time, nor any dys-

pnea—and my diagnosis naturally leaned toward malignancy, and more so when I examined his throat, for the reason that the tumor had not the color and characteristic appearance of tuberculosis. Nor were there any ulcers. Of course, I do not require ulcers for the diagnosis of tuberculosis of the larynx, for I know that there are only about 50 per cent that do have ulcers, but in a case so far advanced as this is, I certainly did look for some. I understand, however, that at the Philadelphia General Hospital they were treating him for tuberculosis of the larynx. I heard of this only lately. Moreover, this man, at the age of sixty years—and I suppose all of you will agree that you will find most of your cases of tuberculosis of the larynx between the ages of twenty and forty years—has no pain, no dyspnea, and nothing except the tumor to indicate that he has tuberculosis of the larynx.

The history of this case, so far as I know, is that he was admitted to the Philadelphia General Hospital, October 7, 1922, and at that time he was losing weight and getting so weak that he could not attend to his work as a plumber. He stayed there about three months and was discharged at his own request and referred to the Phipps Institute; it seems that they did not accept him there as a patient, but sent him off with some pills. On his way home he was taken with dyspnea to such an extent that he had to go into a saloon for help, and they gave him what he called "water." He succeeded in reaching home, but that night he got so bad that he was brought to the Episcopal Hospital in a patrol wagon. When he arrived there his respirations were whistling in character and he was in a semicomatose condition, and they performed tracheotomy immediately, but it seems that he must have gotten some kind of drops in the saloon, because when they were doing this operation he ceased to breathe, and they brought him to by artificial respiration, then he would go to sleep and stop breathing, so they had to keep him awake all night. The next morning he was practically all right. Then they put him in a tuberculosis porch, but a day or so later they brought him into the medical ward as a case of carcinoma. This was confirmed by the ear, nose and throat department on nine separate negative examinations

of the sputum and the fluid that came from his tracheotomy tube; but, later on, after this diagnosis was made, an x-ray of his chest was made and the opinion given that he had lesions there that were suspicious of advanced tuberculosis.

I, personally, do not believe that there is any such thing as a primary tuberculosis of the larynx, although many men say that that is a mistake, that they do occur. Now, here is a man, aged sixty years, who has no pain in his larynx. and is not feeling any discomfort except the discomfort that he finds in breathing through a tracheotomy tube and the fact that he can hardly talk, and who has gained in weight from 121 pounds to 156 pounds since he has left the Philadelphia General Hospital, who is undoubtedly suffering from tuberculosis of the larynx.

(Case presented in person.)

Tuberculosis of the Mouth and Pharynx Complicating Pulmonary Tuberculosis

BY FREDERIC M. STROUSE, M.D.

Patient. A male, aged forty years, machinist, married, father of two healthy children.

Family History. Father and mother living, aged seventy and seventy-four years, in good health. No brothers, three sisters living and in good health, one died in childhood.

Personal History. In childhood he had measles and another ailment was, "swollen all over," but does not know name of disease. Came to this country at age of nineteen years; until present illness smoked fifteen to twenty cigarettes daily; was a moderate drinker, but "occasionally" became intoxicated; since prohibition does not use intoxicating beverages. Claims to have had two attacks of typhoid fever, at age of twenty-seven years, for eight weeks and at age of twenty-eight years for five weeks. Enjoyed good health until eight years ago; taken ill from exposure; symptoms:

pain in left chest, dyspnea and cough; was under treatment for two months and fully recovered (admits having occasional cough, but paid no attention to it) and remained in good health until three years ago; about that time he felt a sore spot on the left side of the soft palate; the doctor said it was an "ulceration," the result of a "bad stomach," receiving no relief; saw another physician, who made a blood test and told him he was "all right;" during all this time, about ten weeks, the ulceration was spreading over the soft and hard palate, buccal cavity and posterior pharyngeal wall; symptoms were: constant discomfort and soreness, especially when swallowing liquids; he never suffered severe pain; becoming discouraged, he resorted to the use of patent medicines. About eighteen months ago he for the first time noticed "swellings" in both sides of the neck, at times quite large and then again scarcely perceptible. No history of hoarseness. December, 1922, was admitted to Jefferson Hospital and remained under observation and treatment, principally in the dermatological department, for about eighteen months, and together with other treatment received about fifty-five hours of radium; from time to time he was referred to other departments—nose and throat, genito-urinary and medical—for examination. Sections were taken from a small growth at the junction of the hard and soft palate, and tubercle bacilli were found. During the time he was under treatment at Jefferson Hospital the Wassermann tests, three in all, were negative. Patient referred to Dr. Skillern's service from Chest Clinic No. 10, on December 26, 1923, with the following report: "A far-advanced case of pulmonary tuberculosis with an infiltration of both upper lobes, more marked on the right." Present condition: Ulceration on lateral aspect of left vestibule (patient claims it was caused by radium), otherwise nasal examination was negative; inside the right cheek a large induration with central ulceration; anterior and posterior pillars glazed or parchment-like in appearance, but no ulceration; this was the result of radium. Perforations of the left anterior and right posterior pillars are of long standing and may have resulted from some disease of childhood. On posterior pharyngeal wall

a large superficial ulcer, $4\frac{1}{2}$ cm. by 2 cm., and extending from the insertion of the palatopharyngeus below to about opposite the floor of the choana above; the ulceration is superficial, with no induration, and covered with a thin mucopurulent discharge. There is a small opening in the hard palate, a radium needle having been inserted here; the base is smooth and covered with connective tissue. Epiglottis and larynx normal. Teeth in good condition and well cared for. Scrapings from ulcers examined at Dr. Kolmer's laboratory negative for tubercle bacilli (negative findings not unusual in secretions and scrapings). Now has constant cough and expectoration. At age of twenty years he weighed 180 pounds, before present illness 162, and now 137 pounds.

Differential Diagnosis. Malignancy; the growth of such tumors is rapid and with early dissemination; for eighteen months prior to admission to Jefferson Hospital he had received very indifferent treatment, therefore undoubtedly fatal termination would have ensued, and, furthermore, laboratory findings were negative. Syphilis: his positive denial, together with five negative Wassermann's and the final test following a provocative injection of arsphenamine, subjective and objective symptomatology negative for lues. Have we lupus, a descending process chronic in its clinical course and eventually terminating in pulmonary tuberculosis, or have we clinical tuberculosis of mouth and pharynx complicating pulmonary phthisis, an ascending process? After careful observation we believe the evidence points to the latter. The drawing presented by Dr. Robert M. Lukens shows how extensive the ulceration was at time of admission to Jefferson Hospital, and if we compare this picture with the condition as we now see it, we cannot be otherwise than deeply impressed by the remarkably beneficial effects of radiation in this case. Dr. Pfahler conferred with us and agreed that henceforth treatment should be conservative. Patient will soon be sent to a sanatorium, and we are hopeful with all that such an opportunity affords, the condition will eventually clear up.

Laryngostomy for Laryngeal Stenosis

BY GABRIEL TUCKER, M.D.

The operation of laryngostomy for chronic stenosis of the larynx is indicated when other methods of treatment, especially dilatation by intubation and bouginage, fail to effect a cure. As you are all well aware, the ultimate success of laryngostomy depends upon the proper technic and procedure at the primary operation, but to an even greater extent upon the after-treatment, which usually extends over a period of from three months to a year. Daily dressing and proper adjustment of dilating apparatus are necessary, as at any time prior to complete epithelialization and dilatation complications may occur which may render the operation worse than futile. The technic followed in these cases is that of Chevalier Jackson. The postoperative dilatation principle of Killian, using a soft rubber dilating apparatus, was used in two of the cases. Certain modifications and changes in apparatus, which appear to be an improvement, were made and will be presented.

Case I. *Atresia of the Larynx Treated by Laryngostomy.*—The first patient is a boy, aged nine years, who had complete atresia of the larynx when admitted to the clinic. The case history revealed lues in one of his parents, primary, nine years before the birth of the patient. The patient had had the usual diseases of childhood, without complications or sequelæ. The laryngeal history began with weakness of voice and croupiness, following a mild attack of influenza three years previous to admission. Diphtheria followed one and a half years later, but there was no laryngeal involvement. Eight months before admission the child developed choking attacks at night with noisy breathing; he was hoarse intermittently, but never aphonic. The attacks became less frequent and severe until three months before admission, when an unusually severe attack occurred. Intubation was attempted without success and tracheotomy was done in

emergency. Three months later the patient was referred to the Bronchoscopic Clinic. On admission the boy was well developed and well nourished. Mirror examination of the larynx showed fixation and infolding of the left arytenoid. The right arytenoid was freely motile. The cords were not visible. No air could be forced through the larynx. The child had a slightly developed buccal voice similar to that of a laryngectomized patient. The tracheotomy cannula was high, passing through the cricothyroid membrane. On removal of the tube no air passed through the larynx. General examination revealed no other indication of disease. Roentgen-ray studies showed the chest negative, and repeated blood Wassermanns were negative.

Laryngostomy was done under ether insufflation. The cicatricial tissue was excised from the larynx and a gauze pack inserted. This was changed daily. Packing was replaced at the end of two weeks by a Jackson laryngostomy cannula with rubber-tube dilator over the upright cannula (Fig. 1). The progress of the case was not as rapid as is usual. There was present an unusual amount of granulations and degree of pharyngitis; the tonsils looked suspicious, and finally an attack of acute tonsillitis developed. After recovery the tonsils were removed. At the same time masses of granulation tissue that had formed in the region of the thyroid cartilage were removed. Following the removal of the infected tonsils the progress was very much more rapid. The apparatus has now been out of the larynx for about three months. The patient has very good motility on the right side of his larynx, and the left is improving. Phonation is with the ventricular bands, but is loud, though deep in pitch. New cords are being pulled out by arytenoid traction. The prognosis is very favorable for a good voice. He is breathing entirely through the larynx, the fistula in the neck being closed with adhesive plaster. (Patient exhibited).

Several courses of protoiodide of mercury have been given, and his general physical condition is very good. Mentally he is bright. The points of interest in the case are:

FIG. 1.—Roentgenogram of laryngostomy apparatus of Jackson in boy, aged nine years (Case I).

First. An infective laryngotracheitis with an undoubted factor of hereditary lues.

Second. Attempted intubation with possible trauma to the left arytenoid.

Third. Emergency tracheotomy was done high and the wearing of the tube for a long time in this position contributed very greatly to the stenosis.

Fourth. The influence of the diseased tonsils. The infective disease developing after the laryngostomy, the tonsillar condition became undoubtedly a factor in the unusual reaction in the larynx. This was clearly shown by the rapid progress after their removal.

Present conditions indicate that the functional result in the larynx will be excellent and that the fistula in the neck can soon be closed.*

Case II. *Cicatricial Laryngeal Stenosis.*—Female, married, aged forty years. Her general health was good previous to the development of a goiter. No respiratory or vocal symptoms appeared until after the removal of this goiter by skilful surgeons in a distant city. Immediately after the operation she developed a bilateral recurrent paralysis. The dyspnea was not relieved until tracheotomy was done eight months later. A two-stage tracheotomy was planned by the surgeons then in attendance and the first stage was carried out. The neck was opened and packed with gauze down to the trachea. The following night dyspnea increased and the patient stopped breathing. The tube was put in through the cricoid in the emergency by the resident physician. On admission to the Bronchoscopic Clinic roentgen-ray studies of the neck and chest were made and found negative for thymus, substernal goiter or pulmonary pathology. Direct laryngoscopic and bronchoscopic examination revealed a narrowing in the subglottic space, but it was thought that ventriculocordectomy would give sufficient lumen for breathing. This was done at four sittings. The results were not satisfactory, due to the subglottic stenosis, and laryngostomy was

* Since this was written the child has been without any apparatus for 6 months and is now completely cured.

FIG. 2.—Roentgenogram of finger-cot covered rubber tube plug of the author's laryngostomy apparatus in use, with trachectomy cannula in position in adult (Case II). This plug is also adapted to the author's laryngostomy tube.

done. The larynx was opened following the Jackson technic. The cicatricial tissue was removed and a gauze pack inserted in the larynx.

The rubber tube dilating apparatus was used at the end of two weeks and at the end of two months very little progress had

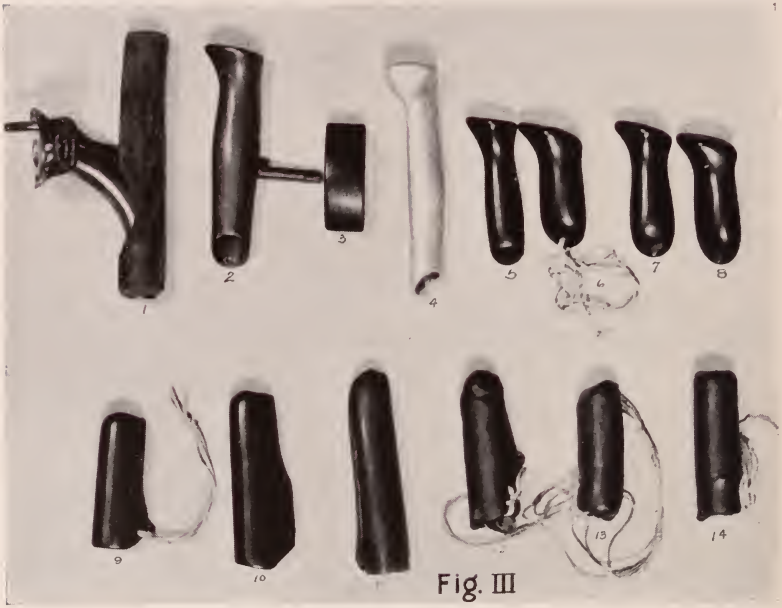


Fig. 3.—Laryngostomy apparatus: 1, Jackson laryngostomy tube fitted with rubber dilating tube; 2, Jackson self-retaining intubation tube showing retaining post and block, 3; 4, Jackson intubation tube; 5 and 6, closed hard rubber plugs; 7 and 8, open hard rubber plugs pulled in from above by means of a string carried up through the larynx from the laryngostomy opening and worn above a tracheotomic cannula; 9, closed; 10, open hard rubber plugs put into larynx from below and worn above tracheotomic cannula; 11, surgeon's rubber glove finger used for covering rubber tubes for plugs. 12, 13 and 14, complete plug with string for attachment to tracheotomy tube.

been made. Granulations were reforming very rapidly and there was very little evidence of epithelialization. The tubing was ground smooth on the edges and boiled thoroughly before using and was shaped very carefully to fit the larynx. There was no evidence of perichondritis, but the larynx simply filled up in spite of all we could do. Dr. George Fetterolf saw the patient, in consultation,

with reference to a possible tonsillar infection and advised against the removal of the tonsils. The larynx was opened a second time under general anesthesia and the obstructing lesions were again

FIG. 4.—Laryngostomy apparatus: 1, finger-cot plug attached to tracheotomy tube, 2, as used in Case II; 3, glass molded rubber tubing core; 4, reinforced finger-cot cover; 5, metal collar of the author's laryngostomy tube used in making closed tube, 6. The open end of the finger cot is inverted into the tube ahead of the collar and a string passed through the loop on the collar, making it secure. A slit in the closed end of the finger-cot opens the tube and allows the patient to breathe through the mouth. This is for use with a tracheotomy cannula.

removed. We continued the use of rubber tubing, but the progress was slow. At the end of eight months the larynx was epithelialized up to the level of the true cords, but every attempt to increase the size of the dilating apparatus above this level aroused

such violent reaction in the arytenoids that it had to be abandoned. We then tried other apparatus that included metal intubation tubes, hard rubber plugs and intubation tubes and retrograde plugs (Fig. 2).

These were used until it occurred to me to try covering a smooth and properly shaped rubber tube with the finger of a surgeon's rubber glove in such a manner as to make the upper end and contact surfaces perfectly smooth. This was tried and caused no reaction. Later we found a special reinforced finger cot (Fig. 3, No. 4) even more satisfactory than the glove finger. The larynx below the level of the cords was now epithelized and a tracheotomic cannula was substituted for the laryngostomy cannula (Fig. 4). The inflammatory condition of the arytenoid eminences and aryepiglottic folds subsided promptly, epithelialization progressed, and, by the addition from time to time of extra thicknesses of glove finger or finger cot, we have brought the size of the plug up to 45 Fr., which seems to be the limit of size of the cartilaginous framework of the patient's larynx. There has been such a marked improvement that we feel the apparatus can very soon be removed for a test period.*

The points of interest in this case are:

First. The initial cause; recurrent paralysis following thyroidectomy.

Second. Emergency tracheotomy through the cricoid cartilage which saved the patient's life though it increased the subsequent difficulties.

Third. Most unusual intolerance to the dilating apparatus. We have never encountered a larynx so intolerant. In this connection it may be noted that the histologic examination of the tissue removed at the second operation showed it to be inflammatory and not neoplastic.

The favorable effects of the use of the glove finger cover in this intolerant larynx led me to use it in other cases, and the results have been very favorable. I have adapted the laryngostomy tube

* The apparatus has now been out four months with steady improvement during the test period.

of Jackson to the use of this apparatus, and have also used a cigarette drain cover for covering the open tube and the gauze packs. I have noted that the use of the finger cot and rubber cigarette cover, by making the surfaces of the apparatus smooth and non-irritating, lessens the tendency to formation of granulation and promotes epithelialization. They permit of an increase of size with the utmost nicety all over the surface of the plug, with an evenness obtainable in no other way.

Case III. *Cicatricial Stenosis of the Larynx.*—Female, aged three years. This child had been hoarse since birth. When she was eight months of age she became dyspneic, and laryngeal examination showed evidence of papilloma of the larynx. Tracheotomy was done and the masses of papilloma were removed. Six months later radium was used in the larynx and at the end of five months a second application was made. A white patch was noted in the pharynx and it was thought that there was a burn due to phenol solution that had been used to sterilize the radium container. Following this it was believed that adhesions formed in the larynx and the child developed complete atresia.

On admission to the Bronchoscopic Clinic eighteen months later the child was fairly well developed and well nourished. The tracheotomy tube was in good position well below the cricoid. There was no evidence of radium burn of the neck. Roentgen-ray examination of the chest was negative. Direct laryngoscopic examination showed the larynx completely closed with firm, swollen tissue. The resulting diagnosis was perichondritis plus papilloma.

The child was kept under observation for three months; frequent direct laryngoscopies were done and at no time was the larynx found patulous. Diseased tonsils were removed preliminary to laryngostomy. On opening the larynx a complete atresia was found at the cricoid level. The thyroid cartilage was split and on careful exploration of the cricoid area it was found that the anterior half of the cricoid cartilage was entirely destroyed. The only remnant of cricoid was an island of cartilage posteriorly

with a pouchlike formation extending upward to the level of the posterior commissure, which was lined with mucosa continuous with that of the trachea. This tissue was incised from below upward and the scar tissue in the larynx cut through in a direction parallel with the long axis of the trachea. The trachea was opened down to the tracheotomic fistula and a pack was inserted. At the end of two weeks a pack, covered with the thinnest rubber cigarette drain cover, was used above the tracheotomy tube.

The child developed chicken-pox, which was epidemic in the ward, and a severe tracheobronchitis. This subsided at the end of two weeks. The wound opened very widely under the pressure of the pack. There was no leakage of food through the larynx on swallowing and it was decided to remove the pack entirely from the larynx, which now showed healthy granulation.

Montgomery tapes were attached to the skin of the neck on either side well external to the sternomastoid muscle and a pad of gauze placed external to the border of the sternomastoid muscle. The tapes were tied over the gauze, pulling the edges of the muscle toward the median line and the skin edges together. A dressing was applied and a laryngostomy tube, with dilating apparatus of rubber cigarette cover, was put in through the old fistula, the lower border of which was epithelialized.

This dressing has been kept up for about a month. The wound is healthy and is epithelializing rapidly. The child coughs through the mouth readily when the skin edges are pulled together with the tapes.

The hope of keeping the larynx and trachea open without the support of the cricoid ring is a forlorn one. But if the present favorable progress continues the wound will soon be completely epithelialized and a deep trough formed in the front of the neck, which will afford an excellent opportunity for the construction of a laryngeal airway by plastic surgery.

The points of interest in this case are:

First. The use of radium rather than the phenol burn resulted in the destruction of the cricoid cartilage from perichondritis.

Second. Absence of a cartilaginous framework presented the utmost difficulty in creating a lumen.

Third. The peculiar pouching upward back of the cricoid remnant was probably due to cough. The same force is now keeping the trachea and larynx dilated without a pack when the skin is pulled together in front.

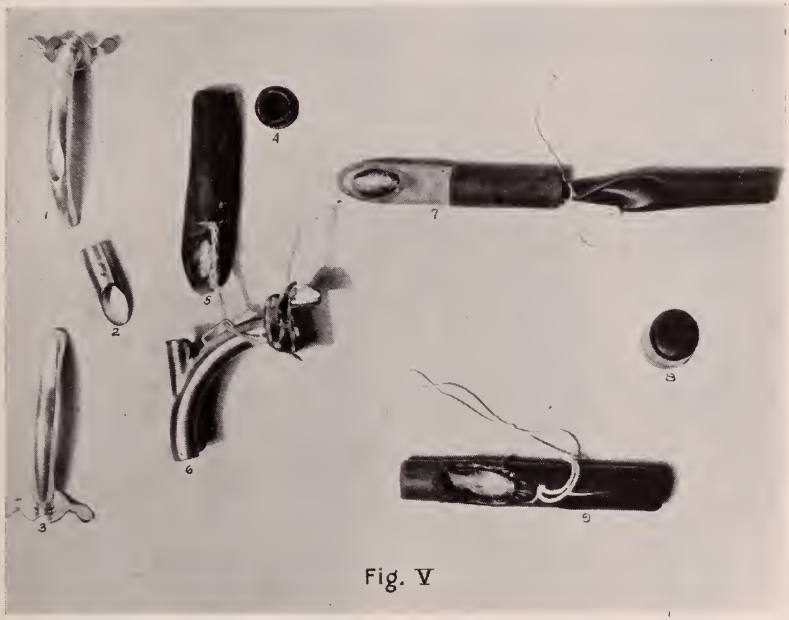


FIG. 5.—Author's laryngostomy apparatus: 1, open inner cannula; 2, collar for attaching rubber dilating unit; 3, closed inner cannula; 4, open end of cigarette drain, 5, covered rubber dilating tube; 6, laryngostomy cannula of the author; 7, extra thicknesses of cigarette drain cover added to tubing to increase size and string tied around cigarette drain cover before it is pulled over to close the upper end; 8, closed end of finger-cot tube, 9. Closed cannula, 3, is used for closed tube, 9. Open cannula, 1, is used for open tube, 5.

For anesthetizing these patients with laryngeal stenosis for laryngostomy I have devised an apparatus for tracheotomic insufflation that has facilitated the work very much, particularly in small children (Fig. 5).

The various forms of apparatus used in these cases are shown in Figs. 3, 4, 5, 6.

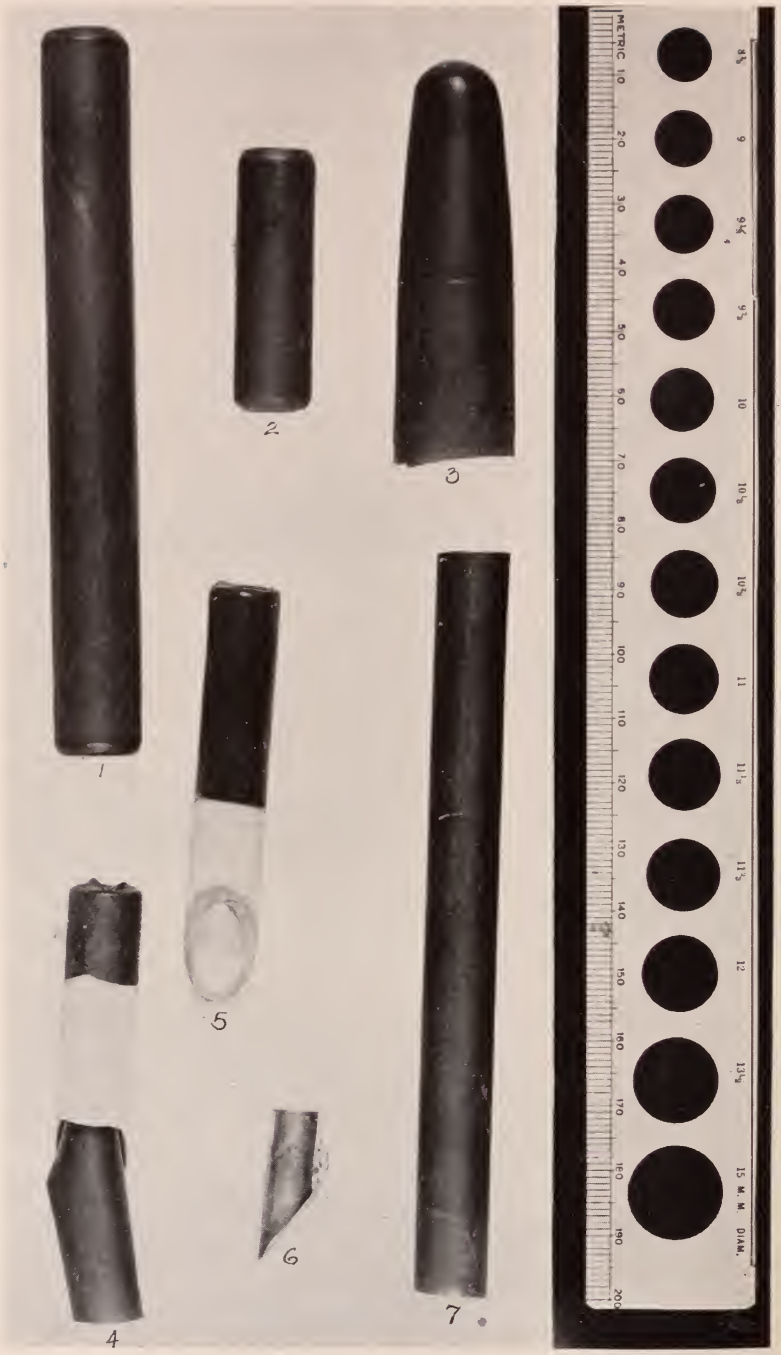


FIG. 6.—Laryngostomy apparatus: 1 and 2, glass molded rubber tubing graduated on French scale; 3, reinforced finger-cot; 4, cigarette drain cover on open tube; 5, extra layer of cigarette drain cover to increase size; 6, laryngostomy collar for holding tubing and finger-cot; 7, rubber cigarette drain cover, "Penrose" tubing.

Most of them were especially devised or modified by me to meet difficulties encountered, for which older forms of apparatus failed to prove adequate.

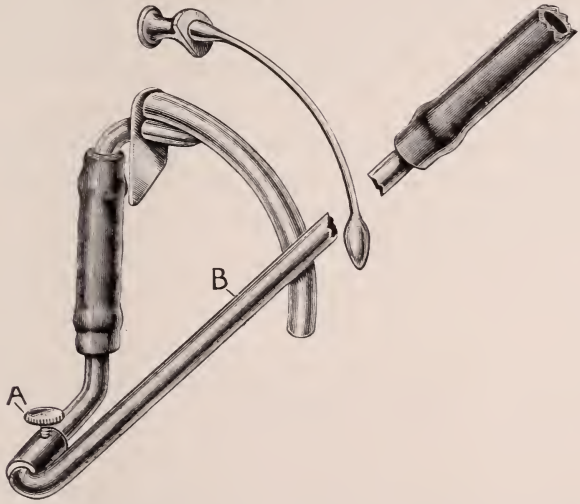


Fig. 7.—Tracheotomic insufflation cannula. For insufflation anesthesia through a tracheotomic opening for operations about the head and neck, such as laryngostomy, laryngofissure and laryngectomy. In laryngectomy it is used through the preliminary tracheotomic wound. In the operation without tracheotomy it is used in the larynx after the larynx is brought forward and also in the trachea after the larynx is severed. It keeps the anesthetist and his apparatus entirely out of the operator's way, expediting the operation by doing away with the interruption for reapplication of the anesthetist's gauze. The smaller size is for use in children; the larger size for adults. The long arm, *B*, enables the anesthetist to get well out of the field of operation above the head of the table.

Conclusions. 1. Cases I and II illustrate the fact that has been strongly emphasized by Jackson, that high tracheotomy is the most frequent cause of laryngeal stenosis, and also the fact that, in patients who have worn the tracheotomic cannula through the larynx, laryngeal stenosis always results.

2. The danger of perichondritis and the resultant stenosis should always be borne in mind when radium is applied to the larynx.

3. Focal infection in tonsils, teeth and upper respiratory tract should be removed before laryngostomy, or as soon as its presence can be determined.

4. The use of the smooth, pure rubber cover (finger cot or cigarette drain cover) over the dilating unit lessens irritation and promotes rapid epithelialization. By the addition of extra "covers" the dilating unit is increased uniformly and gradually in size, adjustment is greatly facilitated and dilatation is much more rapid than that accomplished by the most carefully fitted rubber-tube dilator.

5. The use of the closed tube will control excessive cough due to aspiration of secretions, and its use is important in the early stages of the after-care of layrngostomy cases.

Capillary Angioma in the Larynx of Three-months-old Child

BY WALTER T. ANNON, M.D.

(By invitation)

Almost all types of benign tumors found in other parts of the body occur also in the larynx: lipoma and cystoma on the epiglottis; cystoma on the ventricular pouches; lipoma, cystoma, and papillomata in the arytenoid region; fibromyoma and fibropapilloma on the upper surface of the vocal cords and in the subglottic region. Of benign tumors, the papilloma is most common in children, fibromata in adults, and most frequently in the anterior commissure.

Gerhardt claimed never to have seen an adenoma, a chondroma, neuroma, or angioma in the larynx. Moritz Schmidt, in his work on *New Growths of the Upper Air Passages*, does not report a single case of angioma in a clinical classification of nearly 33,000 cases extending over a period of ten years. Wendell Phillips reported angiomata as usually located about the epiglottis or ventricular bands.

As to etiology, Jonathan Wright says that if these tumors are not the result of chronic inflammatory changes the chronic inflammations play an important role. Measles is said to be an important exciting cause of papilloma in children. Wright maintains that lues and tuberculosis have little influence in producing the innocent neoplasm. Morell MacKenzie claims lues and tuberculosis antagonize neoplastic development, whereas Moritz Schmidt and Lennox Browne maintain the reverse. The "angiomatous diathesis" has been described as parallel to the "warty diathesis" which is present in certain cases of laryngeal papillomata, although the skin and larynx have different embryonic origin.

The angiomata are tumors characterized by newformed blood and lymph vessels or cavities. There are two kinds: (1) Hemangioma and (2) lymphangioma.

The hemangiomata are divided into two types: First, the simple angioma, or angioma telangiectoides, consisting of capillary blood-vessels with more or less connective-tissue stroma; second, angioma cavernosum, consisting of large and small blood spaces lined with endothelium and surrounded by a fibrillar connective tissue.

The lymphangiomata consist of various shaped but dilated lymph channels, which usually contain a translucent material resembling lymph and are separated by little connective tissue.

As to malignancy, the angiomata never metastasize, but may be associated with sarcoma. Semon reported in a study of over 10,000 cases that surgical interference does not tend to convert benign into malignant growths.

The symptoms of laryngeal angioma include congenital or acquired laryngeal stridor, hemorrhage, and dyspnea, with or without the signs of laryngeal obstruction. Subglottic growths cause greater dyspnea than supraglottic growths, although they do not interfere with phonation until reaching the cords, whereas supraglottic growths usually interfere with phonation from the beginning.

The relative frequency of subglottic growths are: (1) Fibroma, (2) myxofibroma, (3) myxoma, (4) papilloma.

Treatment of laryngeal angioma includes usually: First, an orderly tracheotomy, followed by the complete removal with biting forceps, snare, cautery, or radium, using the indirect or preferably the direct method with a laryngeal speculum. Angioma may disappear so completely under cocain depletion that a general anesthetic may be required, preferably intratracheal insufflation. Complete removal of the angioma may require thyrotomy or laryngofissure.

E. R., white, male, aged three months. Admitted to hospital October 2, 1923.

Diagnosis. Laryngeal diphtheria, with question as to enlarged thymus, although not confirmed by *x*-ray study. Temperature, 99°; pulse-rate, 130; respirations, 36.

Family History. Negative.

Personal History. Full term, normal labor, no acute illnesses, but subject to croupy cough since birth.

Examination. Head and neck negative except moderate congestion of nasal and pharyngeal mucosa. Buccal membrane clear. Lungs clear. Some arrhythmia. No evidence of enlarged thymus. Abdomen and extremities negative.

Treatment. 32,000 units of diphtheria antitoxin intramuscularly. Laryngoscopic examination a few hours later by Drs. H. Shaffer and Henry Tucker revealed moderate edema of arytenoids and subacute inflammation of laryngeal mucosa, with moderate subglottic edema.

At this time the child was resting quietly and apparently in good condition.

The child experienced transient attacks of slight dyspnea until the fifteenth day, when his general condition became alarming. Intubation did not relieve dyspnea.

Laryngoscopic examination revealed edema and inflammation of all the laryngeal tissues and a subglottic tumor on the right side. Tracheotomy without anesthesia was performed for laryngeal obstruction, but death soon followed.

At postmortem the larynx contained an angiomatous tumor on

the right lateroposterior wall extending from the right vocal cord to the second tracheal ring.

The thymus was not enlarged and the airway showed no other gross pathology except edema.

The histologic diagnosis was made by Dr. B. L. Crawford as capillary angioma.

The case suggests: (1) Value of direct laryngoscopic examination; (2) early tracheotomy for laryngeal obstruction; (3) angioma as a possible cause of congenital laryngeal stridor.

Vincent's Angina, with Extensive Destruction of Tonsillar Pillars

BY HORACE J. WILLIAMS, M.D.

Miss M. K., aged thirty-five years.

Family History. Negative.

Past Medical History. One year ago the patient states that she had two small ulcerated areas on the posterior part of the tongue. These cleared up under the use of A. G. No 3.

Present illness. During the first week of August, while at Ocean City, the patient noticed a sore throat on the right side. At first she paid no attention to it, but when it continued to grow worse she consulted her family physician, who treated her while she remained at Ocean City, but it continued to grow progressively worse. On October 7, after she returned to Philadelphia, she was sent to my office by her family physician. She swallowed with much difficulty. On the right side there was a deep ulceration in the tonsillar tissue. The right half of the uvula was covered with an exudate. Around the involved area there was marked induration.

The floor was covered with a grayish exudate. There was slight enlargement of cervical glands on the right side.

At this time a culture and smear were taken, which were negative for Vincent's angina. Wassermann was negative.

Following this examination she was treated by her family physician with mercurochrome, 1 per cent, until October 19, when I saw her again. At this time there was almost complete destruction of the anterior pillar, partial destruction of the posterior pillar, marked involvement of the right side of the uvula, more induration around the tonsil, and the cervical glands on the right side were larger.

Dr. Fetterolf saw her on October 23. A piece of tissue was taken for microscopic examination, which was negative. He felt that the condition was Vincent's angina, although the culture and smear were negative.

He suggested neoarsphenamin, 10 per cent, in glycerin, which was used by her family physician and cleared up the lesion in about three weeks, and she was able to return to work December 1, 1923.

FEBRUARY 20

The Purulent Inflammation of Basal Sinusitis and Meningeal Cisterna

BY WELLS P. EAGLETON, M.D.

Perhaps the best way for me to begin this subject would be to give you a résumé of cases and thus call to your attention what we have been trying to do with meningitis; especially since the last report that I made to your Section about eighteen months ago at Scranton, Pa. I do not know whether many of you have read it, but every one thinks that what he does is new. It is told of Bernard Shaw that he became very much interested and excited when he found that Plato knew many things that he (Shaw) had never heard of. I suppose that is the way I feel in regard to this

work on meningitis. Perhaps everything I say is old to you, but I can offer as an excuse that there is a great deal that is new to me.

First, I shall present case histories, postmortems and specimens of the following:

Case I.—F., a girl, who had acute phlebitis of the cavernous sinus from phlebitis of the orbital vein, death resulting from endocarditis and hemorrhage during the operation.

Case II.—John J. A latent case; with chronic obliteration of the cavernous sinus from a chronic lateral sinus phlebitis. No localizing symptoms whatever until the fifty-sixth day of the disease.

Case III.—Rubric. History and pictures. Acute infective phlebitis of the cavernous sinus from orbital venous thrombophlebitis following an acute ethmoiditis. Recovery after ligation of the common carotid and the drainage of the cavernous sinus; by enlargement of the fissure and removal of the orbital wing of the sphenoid. This is the method Mosher described some years ago.

Case IV.—B. Chronic infective obliterative thrombophlebitis of the cavernous sinus from behind, by way of the inferior and possibly the posterior petrosal sinus. Acute phlebitis of the jugular bulb. Recovery, by placing the cavernous sinus thrombus at rest by ligation of the common carotid artery.

Case V.—Straus. Specimen. Infective meningitis of the temprosphenoidal lobe from an osteomyelitis of the temporal bone following an otitis media. Death from general sepsis. Autopsy; showed a subdural meningitis and a purulent phlebitis of the opposite side to that of the original ear trouble. In other words, he had an ear trouble on the right side which was operated upon and cured, but during the same time he had a thrombophlebitis of the left side, which extended from a small cell near the apex of

the petrous pyramid down into the chest, the infection having either arisen from the small cell at the apex of the petrous pyramid or else from the tonsillar vein, and running up and down the jugular on the other side.

Case VI.—P. Specimen. Latent obliteration of the cavernous sinus from unsuspected lateral sinus thrombosis of one month's duration before the appearance of any outstanding symptoms. Death from meningitis and sepsis. The postmortem revealed evidence that the purulent meningitis had been present for weeks, and was controlled by Nature until the general sepsis from the phlebitis had lighted up an acute exacerbation of the quiescent meningitis.

Case VII.—D. Chronic thrombophlebitis, unsuspected for six weeks until outspoken symptoms of meningitis appeared. Successive irrigations from the frontal region to the occiptal and the lumbar region. Death from basal meningitis. Postmortem showed an infective meningitis of all the basal cisterna originating from infective phlebitis of the vein.

Case VIII.—McKean. History: Infective localized meningitis from mastoiditis and labyrinthitis. Recovery following evacuation of the localized collection of the fluid over the base of the middle fossa. No microörganisms in the lumbar region, but high cell count.

Case IX.—K. Purulent meningitis of the basal cisterna. General sepsis, as shown by fluid on lumbar puncture, following fracture of the base of the skull, passing through both petrous pyramids, causing total deafness and discharge of cerebrospinal fluid from one ear. Recovery after evacuation of the fluid from the basal cisterna and irrigation from the basal cisterna back to the occipital region, the opening into the basal cisterna being opposite the apex of the petrous pyramid. Operation followed by

transient facial paralysis, from injury of the nerve entering the hiatus on the superior surface of the petrous bone.

Case X.—Moore. Exudative acute meningitis following otitis media of three weeks' duration, the meningitis having been localized in the basal cisterna for the greater part of three weeks. Acute hemorrhagic exacerbation of the meningitis and sepsis, with death within twenty-four hours after the first outspoken evidence of meningitis.

Case XI.—A specimen of a subdural meningitis from frontal sinus disease, the purulent exudate being entirely in the subdural space. Autopsy showing that all the exudate can be washed away by running water over it, the inflammation not being in the space at all, but outside of the subarachnoid spaces yet under the dura.

Case XII.—Birdsall. History and specimen. Acute hemorrhagic meningitis from unsuspected mastoid disease and brain abscess. Death within twenty-four hours from the onset of the outspoken symptoms.

Case XIII.—Baker. Acute hemorrhagic meningitis.

The specimens of Moore, Birdsall and Baker all show the impossibility of cure in the terminal stages of meningitis when the basal cisterna are blocked by exudate and the septic process is so overpowering as to cause hemorrhages from the small vessels of the pia-arachnoid.

Case XIV.—Lastly, a specimen showing a localized inflammation (a localized abscess) of one week's duration with a capsule, and a localized meningitis. The week after, we find a localized abscess, although it was only one week from the time of the injury in which a piece of the bone punctured the dura.

The relationship between the basal cisterna and the cerebrospinal fluid system is really the title of this paper.

The venous sinuses of the base are divided into two systems, practically divided by the fifth nerve if we approach them embryologically; you will see how practically the whole of the venous system of the base of the skull is divided by the fifth nerve. (See picture showing diagram of the veins of the base of the head.)

The cerebrospinal fluid circulatory system is the result of a high degree of development. It occurs relatively late in life, by evolution tending upward. It is one of the latest of the circulatory systems; when we think of the heart, the veins and the capillaries, they all have a propelling force that drives the blood through them. Nature in its evolution added two other systems, the lymphatic system and the cerebrospinal fluid system, neither of which, however, are supplied with any mechanism to force the contents through its system. Both the lymphatic fluid and the cerebrospinal fluid are moved by the action of the tissues themselves that surround them.

The cerebrospinal fluid circulatory system is absolutely necessary for the proper functioning of the brain. For a long time we regarded it as simply a water bed on which the brain rests, and which was for the protection of the brain from injury. This it serves, but it is only a very small part of its function. It has a very intimate connection with the internal secretions, as is shown in the thyroid. It is in intimate connection with the blood circulatory system; in fact, in the basal cisterna the blood circulatory system is enveloped entirely in the cerebrospinal fluid circulatory system. The cerebrospinal fluid is discharged into the veins through the arachnoid villa, as brought out by Reed, having passed over the cortex of the brain.

The cerebrospinal fluid system allows its fluid to pass into the venous system at other places besides the villi, as shown by Reed's experiments, where, by an increase of the salt in the blood, fluid is drawn from the brain. This is one of the important additions to brain surgery as, at will, we are enabled to reduce the bulk of

the brain itself, simply by increasing the salt content of the blood, which immediately draws out of the brain a large quantity of fluid and so reduces its bulk. This is probably the most important contribution to brain surgery that has occurred in a decade. However, while there is a free communication of the cerebrospinal system with the blood system—that is, ingredients in the cerebrospinal fluid go easily into the blood—there is a barrier on the hemic side between the blood and the cerebrospinal system that prevents substances from the blood entering into the cerebrospinal fluid circulatory system. This barrier prevents any drug or microorganism from passing from the blood into the cerebrospinal fluid circulatory system, and it is by means of this mechanism that Nature protects itself from infection of the brain. If you inject into the cerebrospinal fluid of an animal's head, in the basal cisterna, microörganisms, in a comparatively few minutes the microörganisms will be found in the heart of the animal; but inject as you will, microörganisms into the blood and they do not enter the meninges, except under certain conditions of disturbance; this fact that the microörganisms pass from the cerebrospinal fluid into the blood is of the greatest clinical importance. In fact, this is the way in which Nature keeps this system, the meningeal system, free from infection. If microörganisms accidentally find their way into the system, the cells of the arachnoid multiply immediately as a result of the irritant; they digest or encircle the microorganisms and carry them in their substance up to the large venous plexus, where they are discharged into the blood circulatory system; and so when we see the exudate of meningitis that covers the vertex of the skull, chiefly lying along the superior longitudinal sinus, we must realize that a part of that is simply Nature's protective effort to remove the infection from the basal cisterna.

It is not known how the cerebrospinal fluid circulates, but it is probably a matter of mixture, the result of the impact of the systolic and the diastolic action of the heart, plus the movement from respiration. It is not known where the fluid itself comes from. It probably comes from the blood. Our old conception

that it was originated entirely from the choroid plexus is undoubtedly false, as the choroid plexus contains no secreting elements whatever. This process is probably simply a filter. The fluid, as I said, probably comes from the bloodvessels, and it contains within itself those substances which are necessary for the nutrition of the brain. The nutrition of the brain is probably carried on about like this—it filters through the choroid plexus, or certain ingredients filter through, probably not the fluid, and it then passes through the substance of the brain into the cells of the brain itself and furnishes them with nourishment in the intercellular spaces. The fluid is then gathered in the perivascular spaces running beside the bloodvessels that go to the cortex and passes over the cortical surface, from which it reaches the villa of the superior longitudinal sinus—all the sinuses, in fact—through which it is discharged into the venous system. So we see how intimate is the communication, both anatomically and physiologically, of the blood system and the cerebrospinal fluid system; and this is especially so at the base as here (showing on screen), the veins or arteries are actually lying in the basal cisterna themselves.

If you take the skull of a cadaver and, instead of approaching it in the ordinary way, approach it from behind, so that instead of looking on the brain you look down on its network, you can see that the vessels themselves are in this network. Now, this is exactly the place where nearly all the meningitis of otitic origin has its beginning. It is in the basal cisterna, not at the cortex at all. Almost all our cases of sinus thrombosis kill not by sepsis—the number of deaths from sepsis from sinus thrombosis are comparatively few—but they kill by a terminal meningitis; and if we are to attack the problem of meningitis successfully, we must attack it at a time when the infection is more or less limited to some one part of the system, for if we wait until we have microorganisms in the lumbar puncture it means that all the meninges are infected, and it is just as impossible to remove this as it is to remove the infection from a sponge by simply running a little water over it. But there is clinical and pathological evidence

to show that for long periods of time in cases of meningitis before there are any symptoms of outstanding meningeal irritation, the infection—be it from the ear or from the nose—is limited to one or the other of these cisterna.

Here is a picture that shows the communications of the basal cisterna, and it is in these large spaces (demonstrating) shown in the last picture that the infection occurred.

This next picture is a photograph of a brain from which we took off the skull-cap and then reflected back the brain, trying to get the picture of the system from in front, and note how large these basal cisterna are, extending from just along the optic and well back into the spinal canal.

Sinus thrombosis as a term is a misnomer. We should not say sinus thrombosis. When we say sinus thrombosis, what we mean to say is a septic phlebitis of a large cerebral venous radicle, an entirely different thing from thrombosis. The thrombosis itself is a protective process. If we had nothing but a thrombosis, nothing wrong whatever would happen to us. It would make us right. It is when we do not have a thrombosis or the thrombosis is overcome by the infection that we are in trouble. So it seems to me that one of the things we want to do is to clarify our thought about the term and get rid of it. It is a septic phlebitis of a large venous radicle. This septic phlebitis may be highly septic and cause obliteration of the basal sinuses quickly, in which case we have marked symptoms of blood infection, plus those of a disturbance of the return venous circulation; or at the other end of the picture we may have a low-grade septic phlebitis with a slow obliteration of the veins, in which case there may be very little evidence of the blood-stream infection and none whatever of disturbance of the venous return.

I want to relate 2 cases, two extremes, the one of acute infection and the other of chronic:

F., a young girl. Nine days previously noticed a pimple on the lower lip. This was opened by the patient's mother, after which it

became swollen and inflamed. Monday, the 20th, the doctor was called. The following day he came twice, because it was very painful. Temperature, 103°. Swelling increased. Thursday the 23d, a New York physician was sent for in consultation, who advised an incision of the lip. This was done. A small amount of pus was evacuated. The following day the left eye became swollen. Saturday, the 25th, the *right* eye became red and swollen. The patient became very restless, complained of pain over the left eye, also pain in the neck. When seen and removed to the infirmary the patient, although now only nine days from the time of the original cutting of the pimple, was delirious, face swollen and eyes almost closed—A typical picture of a cavernous sinus thrombosis.

Operation. Enucleation of one eye. Removal of all the orbital contents, according to Mosher's method, as we know that the infection goes in through the veins of the orbit. Removal of the great wing of the sphenoid, thus exposing the cavernous sinus. On opening the cavernous sinus, a few drops of pus found at the apex of the orbit. Death suddenly, at the conclusion of the operation, from the endocarditis, plus loss of blood during operation.

Diagnosis. Acute septic thrombophlebitis of the cavernous sinus from infection of the lip.

On the other hand, the case of John J., gives the following history:

A chronic case. Always troubled with catarrh of the nose and throat. Earache on the right side. Went to work. Came home on account of earache. Two days later he still had earache. The ear was syringed. In a few days the discharge stopped. The ninth day after the original earache he had a chill, lasting for a half hour. Both ears discharged. No pain. Three days later the temperature was 104°. Continued temperature. Was treated by a physician for the grippe. Physician's attention had never been called to the ear. No complaint whatever of the ear. His wife stated, however, that during this

time he had several chilly feelings. On the eighteenth day of the disease he got up and went about as usual, but that night had some fever. Went to work feeling rather badly. Four weeks from the original earache he developed double vision; went to an oculist's office, complaining of headache, but said nothing to the oculist about the ear. On the fortieth day of his trouble he went to his physician's office saying he felt well if it were not for his double vision. On the fiftieth day of his disease he walked fifteen blocks to a specialist's office. His wife, however, stated that at night he felt chilly and hot and could not sleep well. A few days later he complained of severe pain in the back of his neck. On the fifty-second day of the disease, he presented, in addition to the discharging ear and the paralysis of the ocular muscles, a large fluctuating mass in the nasopharynx. The patient now looked sick. Examination by a nose and throat man revealed the following: A bilateral complete paralysis of the sixth and paralysis of the right third nerve. Bilateral choked disc. Swollen and tender glands under the right mastoid. Temperature, 100°. Pulse, 96. The nose and throat specialist stated that he could not imagine that an ear condition could give a bilateral sixth lesion and a partial right third, with a mass in the nasopharynx. He decided that the patient had an involvement of the sphenoidal sinus, put him in the hospital and incised the enlargement in the nasopharynx. The opening drained well. Four days later the temperature rose and the physician opened the other side of the sphenoidal sinus, from which came a gelatinous mass, about fifteen drops, more or less purulent. A few days later the optic neuritis was worse, and he developed suddenly a slight exophthalmos, with hemorrhage of the retina. Septic. Admitted again to the hospital.

Postmortem. Pus in the lateral sinus. Free pus in the entire cavernous sinus of both sides. Right superior petrosal could not be found. Pus in the sphenoidal sinus.

In other words, the man had a low-grade phlebitis which allowed him to go about his work, and did not present symptoms enough

to be diagnosed by good men until the fifty-second day of the disease. He died on the sixtieth day.

These 2 cases represent the two extremes. The one of infection from the lip we see frequently. It is caused almost invariably by the surgeon, because the veins from the face run into the orbital veins and they have no valves. All the radicles of the facial veins are without valves. The infections of the skin are staphylococcic and they are always associated with a protective thrombophlebitis of the small vessels. There is very little pus, but the surgeon sees something on the lip which he has been taught should always be evacuated, and he cuts the local infected area, which is walled off, and then, because he does not get any pus, he squeezes it, and thus lights up an infective thrombophlebitis that retrogrades up through the orbital vein, rapidly attacks the cavernous sinus and causes death. In France they say that they never cut a boil. One of the of the best-known dermatologists in the world says he has never seen a boil that should be cut, because they all get well if they are not cut, and a great many patients die if they are cut.

Between these two extremes there are all grades of infection through phlebitis of the large basal sinuses; and when we think that John J. almost got well, we must realize that many of the obliterating infections of the large basal sinuses do recover; but, as a rule, all infections of the basal sinuses end in meningitis unless attacked surgically, and this surgery, to be successful, must first of all follow the route of infection; and, second, the parts after being drained must be placed at rest. Now, this is impossible in the cavernous sinus because of the internal carotid artery which passes in the lumen of the cavernous sinus itself. We have long known that all forms of phlebitis, whether it be of the hand—and I had an infection of the hand myself last year, and when you look at your hand for weeks and have time to think a lot, you wonder whether you are ever going to get well—we have long known that all forms of infective phlebitis, be it of the leg or the hand, or what not, must have rest or it will extend.

This has been well recognized in the leg, because it was long ago found out that if a man had a mild grade of infection in the vein of his leg, and he is allowed to walk, it always extends simply by contraction of the muscles around the infected vein. As far as I know, no one has realized that in the large venous sinus of the head, the cavernous sinus, rest is impossible because the internal carotid artery passes through the cavernous sinus and pounds away, just the same as if a man is constantly walking with the vein in his leg inflamed. To my mind, it is this movement of the pulsation of the internal carotid artery in the cavernous sinus which has been the cause of all the cases of cavernous sinus thrombosis, ultimately involving the opposite side.

Germaine, in 1904, collected all the reported cases of cavernous sinus thrombosis up to that time, and found that 7 per cent of them recovered spontaneously, so we can say that some cases of cavernous sinus thrombosis do recover; but up to the cases I am going to report tonight, I know of no cases of cavernous sinus thrombosis that have ever recovered through surgical intervention, and this I believe because the surgical indications have not been met—that is, drainage through the path of original infection—and, second, rest supplied, after drainage of the cavernous sinus, by ligation of the common carotid artery.

(Picture.) This picture is taken from Makuen's well-known atlas. It simply shows the network of veins that run from the nose up into the orbit, and so back through the orbital vein into the cavernous sinus.

Now, in these cases of cavernous sinus thrombosis the infection either originates from the lip, the nose or from an acute involvement of the ethmoid cells, all causing the same thing, an infective phlebitis of the orbital veins, and this retrogrades because of the absence of valves.

(Picture.) Name of patient, Rubric. History: October 6, had a cold in the head. Was always subject to colds in the head.

Had hayfever in summer. October 9, had pain in the nose and eye. Came home from school. Was seen by two physicians because one of the eyes began to swell. October 10 the eye was better. Thought to have an orbital cellulitis. October 15, pain in back of neck. She went away and did not return. Exophthalmos of one side. This subsided and the oculist who was treating her decided not to incise it. He then went down to Washington to attend an ophthalmological congress, believing the case was one of threatened orbital abscess. October 15 the eye began to swell again. The veins were dilated and the movements of the eyeball were now limited. She was seen by another oculist, who sent her to the hospital, and on admission there was on the right side exophthalmos; left side, marked exophthalmos. Movements entirely limited. Papilloedema of the right. A typical picture of cavernous sinus thrombosis. The one thing to my mind that impressed me more than anything else was what the second oculist said: "That is not an orbital cellulitis, because it is too blue, there is a difference;" and when he called my attention to it, it was easily recognized—the difference between the swelling due to venous obstruction and the ordinary swelling which is due to infiltration of round cells into the tissues. There is a difference in the look of the lid which, when your attention is called to it, is decidedly characteristic.

Operation. Ligation of the external carotid will stop the bleeding around the face, but as we wanted to stop the bleeding from the ophthalmic I decided to ligate the common carotid so as to stop the hemorrhage during the operation. The common carotid was ligated without difficulty and the whole orbit exenterated. At the apex of the orbit we found some veins thrombosed.

(Picture shown of the orbital vessels with the thrombosed area.) A part of the orbital portion of the great wing of the sphenoid was removed. We could see the cavernous sinus very well. I then passed a probe through the lumen of the ophthalmic vein into the sinus back as far as the petrous portion. Nothing came out. Much to our surprise this child made an absolutely uninterrupted

recovery. There can be no doubt that she had a cavernous sinus thrombosis, because she had a papilloedema of the other eye, which continued for weeks afterward.

The thing that impressed me was the tremendous influence which was exerted by simply opening this vessel. I had never seen anything like that in lateral sinus thrombosis. Then it occurred to me that perhaps it was because the vessel had been placed at rest by the ligation of the common carotid.

When a case presented itself of lateral sinus thrombosis in which I could not get bleeding from below, the following procedure was adopted:

Brunner. Attack of tonsillitis in August, followed by an abscess in the ear; opened by a physician. Since then the right ear has been running. Headache. No deafness. Five weeks ago had a chill. This was repeated three times in one week. No chill since. Temperature, however, continued going up and down, sometimes reaching 104°. Blood culture was taken and found to contain streptococcus hemolyticus. Treated by serum for some time. Suddenly developed a slight papilloedema of the eye, with sudden pain behind the eye, and when we saw him four weeks from the beginning of his infection, he had papilloedema of one eye, a history of a lateral sinus thrombosis and small hemorrhages into the eye.

Diagnosis: Lateral sinus thrombosis.

Operation revealed a large septic clot over the sinus. Found the usual clot broken down and obtained free bleeding, but posteriorly, toward the jugular portion no bleeding. The temperature continued going up and down. Had two or three chills. The pain behind the right eye became very intense and the boy presented the appearance of a case of meningitis. Developed enormous veins in the back of the eye with a large number of hemorrhages.

With our previous experience, as we now believed the boy had a cavernous sinus thrombosis, we ligated his common carotid on

the same side, went down again toward his jugular bulb, and when we came well down into the bulb found a piece of cotton which I had left there at previous operation. On removing this we got a tremendous rush of pus. From that time all the symptoms rapidly subsided and the boy went on to an uninterrupted recovery, although it took a long time for the papilloedema and hemorrhages to disappear.

Diagnosis. Thrombophlebitis running through the inferior petrosal, involving the cavernous sinus.

I have treated or seen in consultation 17 cases of cavernous sinus thrombosis, of which I have autopsy records of 9. Of these 17, 4 have recovered, 2 besides those reported. In the 2 others there always must be some doubt of there being a cavernous sinus thrombosis, because pus was found in the apex of the orbit. In 1 case there was general sepsis with multiple abscesses, so it is a fair inference that it was a case of cavernous sinus thrombosis.

Now, what is the relationship between septic phlebitis and meningitis, and what can be done when the latter occurs?

Straus. Case of infective phlebitis of the lateral sinus, the jugular bulb, and the vein on the opposite side from the infection of the ear; after the originally infected side had been cured.

The man had a mastoid, was operated on by a very good physician and then began to develop symptoms of meningitis. When he was seen by me I said he had a localized meningitis. We opened the well ear and found an area in the squamous plate of the temporal bone. We removed this and found an infected dura. Opening under the temporosphenoidal lobe we evacuated a large quantity of septic fluid. He gave a history (some time before) of having had a sore throat and a little trouble in swallowing, but after we had evacuated the septic fluid the man continued to show signs of sepsis; he would have a chill and his temperature would go up. His blood cultures remained positive. At last the man became highly septic. We gave him a transfusion. Following the second transfusion he went into collapse and died.

Autopsy revealed that he had had a localized meningitis of the side operated on and that we had cured it by the operation, but that deep in, there was one cell toward the apex of the petrous portion of the temporal bone of the same side which had pus in it, and on the opposite side, in the superior and inferior petrosal, the jugular bulb and the lateral sinus, and going down into his chest, there was a purulent condition of the venous sinuses.

Whether this purulent venous infective thrombophlebitis of the left side came from that one cell of the right side, or whether it originated from an infection of the tonsil involving the jugular vein, of course we do not know.

Another interesting feature about the postmortem is that he had a subdural meningitis, a meningitis over the sphenoidal sinus which was in the subdural space, not in the arachnoid space.

Penzlack. Following grippe, an unsuspected case of lateral sinus thrombosis going on to cavernous sinus thrombosis. Five weeks previously, following grippe, the right ear began to discharge and continued off and on ever since. The following week the left ear began to discharge and became painful. When first ill with what was thought to be grippe, she had chills and was then better until the day before she entered the hospital, when suddenly the left eye began to swell. Two days before she had been examined by a very good man and thought to have beginning pneumonia. Had pain in one side of the neck and in the top of the head. Admitted to infirmary in deep coma. Stiff neck. Delirious. Blood culture, negative. Lumbar puncture revealed a large amount of fluid. Died in coma within twelve hours after admission.

Postmortem. Free pus in the left lateral sinus extending from the jugular bulb to the torcular. The physicians had never suspected that the trouble came from the ear. The superior petrosal was free of infection. The infection extended around to the right inferior sinus, which was filled with a clot. This clot was aseptic, a protective process trying to wall off the infection. Deep in the petrous pyramid there were a few cells which were

affected along the carotid artery. The brain over the cortex showed isolated masses of pus. The basal cisterna were filled with exudate, filling the interpeduncular space. Around the cerebellar tonsils the meninges were eroded either from pressure or hemorrhages. It looked like an old process which Nature had walled off until the terminal stage, when in twenty-four hours the picture changed from something mild to a virulent brain infection.

But you will say all cases of meningitis of nasal origin are not associated with septic phlebitis of the basal sinuses. True, a large proportion is not, but examination of about 100 cases in autopsies show that 27 per cent of all cases that die from meningitis originated from septic phlebitis of the basal sinuses. About 13 per cent originate from brain abscess and about 20 per cent from causes unknown, while another 10 per cent originate from phlebitis of the bones of the skull. So we can say that a large proportion of the cases of meningitis have an infective phlebitis either of a large or a small dural vessel as the cause of the meningitis. This is proven by the following case: (I think if we would conduct all the postmortems a little more carefully we would find these little thrombosed infective vessels running from the mastoid area or petrous pyramid into the leptomeninges.)

Dolson. This patient had his tonsils removed, since which time he had more or less earache. (Do you ever think of the number of cases that die directly or indirectly from the removal of adenoids and tonsils? I am impressed with the number of cases that ultimately go wrong every year.) About six weeks ago he had a cold in the head, then was better, then at irregular periods had temperature. No chill. Irregular headache. Ear negative, but the upper wall of the left canal hung down. For six weeks, had almost a continuous temperature; then had an attack which looked like enlarged glands, and in a few days developed a diplopia. The external rectus of the left eye became paralyzed. No tenderness over the mastoid. However, an *x*-ray revealed a cloudy mastoid. Lumbar puncture resulted in fluid found to the amount of about 150 cc and positive microörganisms. Was taken to the infirmary with a diagnosis of meningitis and

unsuspected mastoiditis. Mastoid opened in the usual way. Effort made to wash it out partially successful. He was returned to bed. The immediate effect is usually good from this procedure. He soon began developing again meningitic symptoms, and died.

Postmortem revealed mastoiditis on the left side. No edema. Small wound over the right frontal about a half inch. Beneath this there was an opening and a small clot over the dura. Two needle holes. Convolutions flattened. Exudate beneath the pia-arachnoid. Marked internal hydrocephalus. The sphenoid contained pus which showed streptococcus. Small amount of pus at the apex of the petrous pyramid, above which was a small thrombosed vein entering the dura, through which undoubtedly the infection occurred.

This experience makes me believe that if we examined our cases carefully after our mastoid operation we would find that nearly all the cases of mastoiditis have had a period in which they have had meningitis, but it has been latent and confined to the basal cisterna. This is a rather broad statement, but it is the result of a rather wide experience. The history is always about the same. They have a running ear. Paracentesis is made, a few days later a mastoid and the child is thought to be doing well, but he vomits once in a while and has a little headache. He goes home. In a week or ten days, or two weeks, suddenly he awakes in the middle of the night with a terrible pain in his head. Lumbar puncture is done, microörganisms found and in a few days he dies. If we examined these cases carefully we would find that during this period they have had meningeal symptoms, which shows that the meningitis is confined to the basal cisterna until at last it overcomes the barrier and attacks the whole of the basal system. If we attack them surgically in the terminal stage we do them no good; but in the exudative stage, when they are still around and about, in the early stage of meningeal symptoms, something can be done surgically, if we attack the site of the original infection and remove the infection from the cerebrospinal-fluid system while it is still limited.

McKean was a case that had a mastoid, and then one day did not feel well; suddenly developed facial paralysis with a diplopia. We told his father he had meningitis. We opened him immediately under the temporosphenoidal lobe. The dura did not pulsate. We made a slight opening and got a large amount of infected fluid and the boy recovered.

I have seen a rather large number of these cases, and if we open them in the place that they are infected, as in Strauss' case they do well. If you have an ostitis here (indicating on picture) you open directly behind this, but if it starts from the median line and you open laterally, you get a little fluid and the brain comes down and stops it. In these cases it is necessary that we open the basal cisterna itself.

(Picture.) This shows the exudate over the basal. In a case like that there is no use trying anything.

(Picture.) If you follow the course of the petrous pyramid and go well into the apex of the petrous pyramid, you can open the basal cisterna. Some time ago I talked over the feasibility of this, but during the last year a man came in with the following history:

Thrown from a wagon, striking the top of his head. Brought into hospital unconscious. Soon came out of his unconscious condition and said he could not hear. Totally deaf in both ears. From one ear there was a discharge thought at first to be blood, but on the following day it was found to be cerebrospinal fluid. He presented a picture of a basal fracture. The accident occurred on a Friday. On Sunday his temperature rose to 101° and in a short time to 104°. He was mildly delirious and had a stiff neck and all the symptoms of meningitis. We thought he was going to die; but that an operation might save him. His family agreed to it. We made a large incision, removing the bone and came to the hiatus of the facial nerve. In doing the Gasserian ganglion operation I have more than once caused a facial paralysis and could not understand it. I wondered why it was followed by facial paralysis, but in this case we ran right along the side of the superior petrosal, and it was very easy to elevate the brain because the man had been

discharging cerebrospinal fluid and the brain was easy to enter, we came to this hiatus, and I saw what looked like an artery, and then realized that it was a vessel and also a nerve. Afterward, when I went home and studied up anatomy, I found that that was the greater petrosal. Although the man had been leaking cerebrospinal fluid several days, and although the brain was very flaccid, when we cut into the basal cisterna we got a tremendous gush of fluid. We found he had streptococci in the cerebrospinal fluid from his lumbar region. The man recovered.

This case has taught us that the lavage of the subarachnoid by irrigation of the basal cisterna is feasible, and it should be done early. It is a safe proposition.

(Referring to specimens.) The one specimen I want you especially to look at is this one of a meningitis of the subdural space. It was not of the pia-arachnoid at all. I opened this from the frontal sinus and washed out a great quantity of fluid. When we washed the exudate away we saw that the pia-arachnoid was perfectly normal. All the purulent exudate was in the subdural space. These cases are not so uncommon, subdural meningitis, not subarachnoid infiltration. These cases should give a high percentage of recovery.

MARCH 19

Lantern Demonstration of the Pathology of the Tympanum and Labyrinth as Illustrated by the Fraser Slides

BY RALPH BUTLER, M.D.

(*Abstract*)

Dr. Ralph Butler presented a lantern demonstration of the pathology of the tympanum and labyrinth as illustrated by the Fraser slides. Twenty-five lantern slides were selected from the

Dr. J. S. Fraser collection, illustrating the pathology of the tympanum and labyrinth. The slides illustrated normal anatomy of the tympanum and vestibule, purulent otitis media, fistulæ in the semicircular canals, labyrinthitis, developmental defects of the cochlea, fractures and war injuries involving the ear and tumors of the auditory nerve.

This work has been done very beautifully and thoroughly by Dr. Fraser, and some idea of the detail and instruction to be had from this collection can be gleaned by noting the structures depicted by these twenty-five slides, which are only a small part of the collection.

Slide 1. The facial nerve as it passes over the cochlea.

Slide 2. Coronal section of the normal drum-head, tympanum and vestibule, including the anterior part of the utricle.

Slide 3. Bony ankylosis of the incus to the facial canal.

Slide 4. Bony closure of the oval window.

Slide 5. A vertical section of the inner wall of the tympanum and normal vestibule, including the crista of the posterior semicircular canal.

Slide 6. A section showing a great overgrowth of the stria vascularis and malformed Corti's organ.

Slide 7. A section of the normal crista of the posterior canal.

Slide 8. An axial section of the cochlea, showing dilatation of the cochlear duct in all coils.

Slide 9. A horizontal section showing a fracture through the footplate of the stapes and vestibule, with hemorrhage into the cochlea.

Slide 10. A vertical section through the tympanum and cochlea, showing a purulent otitis media and hemorrhage into the cochlea.

Slide 11. A section showing acute purulent otitis media.

Slide 12. A vertical section of the cochlea, showing hemorrhage around branches of the cochlear nerve.

Slide 13. A horizontal section of the tympanum, showing a ruptured drum-head, with hemorrhage and pus in the hollow of the stapes.

Slide 14. A section showing a fistula in the lateral canal.

Slide 15. A section showing circumscribed labyrinthitis in the convexity of the posterior canal.

Slide 16. Showing invasion of the inner ear through the lateral canal.

Slide 17. Showing acute purulent labyrinthitis, with invasion through the lateral canal.

Slide 18. A section from the same through one coil of the inflamed labyrinth under high power.

Slide 19. Showing acute labyrinthitis, with invasion through the oval window.

Slide 20. Showing new bone formation in the labyrinth.

Slides 21 and 22. Two sections showing purulent exudate throughout the cochlea.

Slide 23. Showing one turn of the same under high power.

Slide 24. A horizontal section showing a tumor of the auditory nerve.

Slide 25. A section through the basal coil of the cochlea, showing the absence of Corti's organ, atrophy of ganglion cells, adventitious connective or tumor tissue, large vein and new bone formation in the scala tympani.

Demonstration of Specimens Illustrating the Anatomy of the Temporal Bone

BY WARD C. ALDEN, M.D.

(*Abstract*)

Dr. Ward C. Alden (by invitation), presented a demonstration of specimens illustrating the anatomy of the temporal bone. Dr. Alden explained that this work on dried specimens of the temporal bone was made possible by the professor and his assistants in the department of otolaryngology at the University of Pennsylvania Post-Graduate School.

His endeavor was to simplify this work and to limit the cuts to the fewest possible, and to comply with certain mechanical requisites for assembling and disassembling for ready reference in use. Two complete skulls, showing the positions of the sinuses and their principal avenues of surgical attack, were demonstrated, also a number of photographs were presented of selected dissections.

In addition to the specimens showing the anatomy of the temporal bone, the radical and simple mastoid operations have been very beautifully worked out.

Dr. Alden also demonstrated the mechanical methods in reassembling and preserving specimens, with the tools he most commonly used.

The Prognosis as to Hearing

BY GOUVERNEUR H. BOYER, M.D.

(By invitation)

Section I. *General Remarks.* The figures to be given were tabulated in order to find a basis for estimating the probability of improvement, under treatment, of cases presenting themselves for treatment of affections of the hearing. The series of cases presents certain advantages for this purpose, in that it covers a special population in which an exceptional degree of attendance could be secured, and in which there was little tendency to select clinics for special reasons. It includes all the cases seen for any complaint as to the ears and hearing, and all in which affections of the ears and hearing were discovered without complaint, at the eye, ear, nose and throat clinic of the Fort Bliss Base Hospital; its successor, the Fort Bliss Station Hospital; and its successor, the William Beaumont General Hospital, at any time from November 22, 1919, to December 31, 1922, if discharged from treatment by the latter date, no selection or exclusion being made.

Methods of treatment will not be discussed, as they are foreign to the purpose of this paper. It may be assumed that the methods used were those in general use, and recognized as standard, applied with rather more regularity than is possible in most out-patient clinics, because of the special character of the clientele. This consisted largely of officers and soldiers whose attendance could be secured very regularly. A smaller number were officers' and soldiers' families, and their attendance was also more satisfactory than is usual in civil practice. Over one-third of the cases classed as defects of hearing, and over one-half of those in whom treatment was instituted, persisted in treatment long enough for an estimate to be made of the results. The figures to be given relate to individual ears, not to patients; the number of patients being, of course, somewhat smaller. The results claimed will not be found exceptional, but I think they represent a fair approximation to the probable outcome of unselected applicants for treatment. They also represent accurately the incidence of ear affections in young adult and adult life, as all the officer and soldier patients who make up the bulk of the list were normal so far as ordinary examination would disclose on entrance into the service. The final results are also probably correctly represented, as the nature of the population served makes it highly probable that recurrences or relapses would be seen at the same clinic. All readmissions are continued under the original record, and the result of a case appears but once.

The study relates to ailments mostly minor and not operative, interfering with hearing or with comfort, but not with the ambulatory status. Ward admissions are not included unless treated as ambulatory in the clinic.

A considerable number of cases are classified as "untreated." The causes for non-treatment were as follows:

1. Attending for another ailment, on recovery from which treatment for the hearing defect was refused.

2. Normal hearing, no complaint by patient. No indication for treatment.

3. Eloped before examination was completed.

4. Referred for examination and recommendations only.
5. Referred for examination and diagnosis only.

No selection of cases for treatment was made on the basis of probable benefit, but treatment was offered to every case except certain cases of nerve deafness were given a very poor prognosis, which no doubt influenced them to go untreated, when they could have been persuaded to accept treatment. I regret this very much, as it will appear that the nerve cases had probably nearly as good a chance for improvement as the conductive cases, and certainly much better than the cicatricial.

The time covered is three years and six weeks in one clinic, so that errors due to carrying over at the beginning and at the end of the period are not significant. Cases carried over from a preceding period are included; those carried over to a following period are not included.

I should like here to make some remarks on examination of hearing by the whispered and the spoken voice.

The method used was to whisper slightly, forced, at the end of an ordinary expiration. This not only gave uniform results when used by one examiner, but gave very close agreement when used on the same patient on the same day by different examiners, results commonly agreeing within 10 per cent. Only three-syllabled numbers were employed, excluding "s" and "x" sounds, and the patient's hearing was recorded as the number of feet at which he could repeat correctly three out of four numbers, with the ear under test turned toward the examiner and the other closed by his finger. The space available for testing was a very silent corridor, 40 feet long. The whisper was tested on normal and on defective ears and was heard by normal ears the full length of the 40-foot corridor; at 50 to 55 feet in a silent ward, 55 by 22 feet, and on a dead still day out of doors at 55 feet. With defective ears hearing at less than 40 feet, the whisper was heard at equal distances in the corridor, in the ward and out of doors. This finding was unexpected and was confirmed by repeated tests of different persons. The slightest sound of wind, with windows opened, reduced the distance of hearing by such

amounts as 50 per cent. Presence of a third person near the examinee, although making every effort to be silent, reduced the distance of hearing noticeably. Opening the windows along the corridor and in the ward, in the absence of wind, did not affect it. Testing in another corridor, although silent, whose walls were broken by door frames, and which opened at each end into a larger cross-passage, reduced it more than 50 per cent.

A low conversational voice was also used and examiners were trained to imitate the tone of doctor. Results here also checked very closely as between examiners. The distance for normal ears with the low conversational voice was found to be around seventy feet.

Most patients, and toward the end of the three-year period all patients, were frequently tested by both whispered and spoken voice, for the reason that the records of many had been started on the basis of whispered voice, and later records, based on low conversational tones, were required; the double method was continued because it furnished information of value. A clinical advantage was early shown in that with defective hearing, hearing was not reduced equally for whispered and low, spoken tones, conductive cases rather frequently hearing both at about the same distance, while perceptive cases had loss of hearing to the whisper out of proportion to loss of hearing for resonant speech. In some of these cases the hearing for whisper was at two feet while that for spoken voice was twenty. The hint obtained by the double test, done by a technician, was of value in indicating with a minimum of effort the line of study to be followed.

Air and bone conduction were compared and an estimate of bone conduction against the normal was made, with a fork of 128 double vibrations per second, and Weber's test applied with the same fork.

When there was a wide disparity in the hearing of the two ears, it was not found profitable to study the hearing of the poorer ear while the good ear was stopped with the finger, and irrigation with water at 104° was used to exclude the good ear. With the finger pressing the tragus lightly into the external meatus the whis-

per can be heard at $1\frac{1}{2}$ feet and the low spoken voice at 5 feet by a normal ear.

SECTION II.—TABLES

1. Affections Chiefly Significant as Defects of Hearing, 405 Cases

		Treated.	Cured.	Improved.	Unimproved.	Quit.	Untreated.
Nerve deafness	33	16	2	4	6	4	17
Mixed deafness	17	15	1	2	5	7	2
O. M. C. C.	323	210	17	42	49	102	113
Healed O. M. S. C.	26	10	1	2	7	0	16
Otosclerosis	6	2	0	0	2	0	4
Total	405	253	21	50	69	113	152

2. Affections Chiefly Significant as Acute Infections, 394 Cases

		Treated.	Cured.	Improved.	Unimproved.	Quit.	Untreated.
Eczema of canal	28	27	17	3	0	7	1
Acute mastoiditis	4						
Acute suppurative otitis externa	58	56	43	1	0	12	2
O. M. C. A.	161	156	92	9	2	53	5
O. M. S. A.	143	134	67	9	14	44	9
Total	394	373	219	22	16	116	17

3. Affections Chiefly Significant as Chronic Infections, 92 Cases

		Treated.	Cured.	Improved.	Unimproved.	Quit.	Untreated.
O. M. S. C.	86	75	20	9	7	39	11
O. M. S. C. with nerve deafness	2	1	0	1	0	0	1
Chronic mastoiditis	2	2	0	1	0	1	0
Sequelæ of mastoid operation	2	0	..	..	..	..	2
Total	92	78	20	11	7	40	14

4. Affections Chiefly Significant for Diagnosis, 95 Cases

Adenitis, non-otitic	5
Arthritis, temporomandibular	6
Exostosis	2
Hypochondriasis	2
Malingering	6
Syphilis, undetermined lesion	1
Parotitis	2
Pruritus	2
Abscess of tragus	1
Painful scar of cheek	1
Comedo of concha	1
Chronic abscess of scalp	1
No diagnosis	30
No disease	35
Total	95

5. Foreign Bodies, 243

Gravel	2
Cotton	5
One four years; one with O. M. S. C. recovered normal hearing,	
Live tick	6
Dead tick	1
Cerumen	226
Cholesteatoma of canal	3
Total	243

6. Injuries, 23

Hematoma of auricle	3
Punctured wound, canal and drum	1
Lacerated wound, tragus, concha and canal	1
Abrasion of drum	2
Abrasion of canal	2
Lacerated wound, canal	1
Unspecified wound, canal	1
Rupture of drum	2
Infected wound, tragus and concha	1
G. S. W., canal	1
Powder burn, with O. M. S. A.	1
Tar burn	1
Gasoline burn	3
Contusion, external ear and mastoid	1
Fracture of mastoid, suppurative mastoiditis	1
Fracture involving ear	1
Total	23

7. Nerve Deafness. Hearing of Treated Cases, 16 Cases

	Final hearing.	10/40 and under.	20/40 and under.	30/40 and under.	Over 30/40.	No record.
Initial hearing						
10/40 and under		**5**	3	0	2	
20/40 and under		....	**1**	....	....	2
30/40 and under		....	....	....	....	
Over 30/40		....	....	....	**1**	2
No record.						

8. Mixed Deafness. Hearing of Treated Cases, 15 Cases

	Final hearing.	10/40 and under.	20/40 and under.	30/40 and under.	Over 30/40.	No record.
Initial hearing						
10/40 and under		**5**	1	1	..	7
20/40 and under		....	....	....	1	
30/40 and under		....	....	....	..	
Over 30/40		....	....	....	..	
No record.						

9. Chronic Catarrhal Otitis Media. Hearing of Treated Cases, 108 Cases

	Final hearing.	10/40 and under.	20/40 and under.	30/40 and under.	Over 30/40.	No record.
Initial hearing						
10/40 and under		**14**	2	3	8	5
20/40 and under		5	**3**	....	2	2
30/40 and under		2	1	**1**	4	
Over 30/40		2	....	2	**20**	11
No record		....	1	1	2	17

10. Healed Chronic Suppurative Otitis Media. Hearing of Treated Cases, 10 Cases

	Final hearing.	10/40 and under.	Over 30/40.	No record.
Initial hearing				
10/40 and under		3		
20/40 and under			1	1
"Normal"				2
No record				3

11. Chronic Suppurative Otitis Media. Hearing of Treated Cases, 37 Cases

	Final hearing.	10/40 and under.	20/40 and under.	30/40 and under.	Over 30/40.	No record.
Initial hearing						
10/40 and under		5	2		1	
20/40 and under			2		2	2
30/40 and under					2	
Over 30/40					3	6
No record		2			2	8

12. Otitis Media, Acute Catarrhal. Hearing of Uncured Cases, 11 Cases

10/40 and under	2
20/40 and under	1
30/40 and under	2
No record	6
Total	11

13. O. M. S. A. Days of Treatment in "Cured" Cases, 67 Cases

Days treated.	4	6	7	8	9	10	11	14	15	16	17	19	20	21	22	30	38	60	120	No record.
Cases	3	3	2	1	1	3	1	1	1	1	1	1	1	2	1	4	1	3	1	35

14. O. M. S. A. Hearing in Treated Cases, 90 Cases

10/40 and under	7
20/40 and under	2
30/40 and under	1
Over 30/40	20
"Normal"	1
No record	59
Total	90

15. O. M. S. A. Fate of Uncured Cases, 23 Cases

Healed with impaired hearing	13
Progressed to chronic suppuration	8
Meningitis; death (one patient)	2
Total	23

16. O. M. S. C. Days of Treatment in Healed Cases, 26 Cases

Days of treatment.	6	8	11	12	14	21	30	3 months.	6 months.	No record.
Cases	1	1	1	2	1	1	2	3	2	12

17. O. M. S. C. Hearing in Healed Cases, 24 Cases

	Final hearing.	10/40 and under.	20/40 and under.	30/40 and under.	Over 30/40.	No record
Initial hearing						
10/40 and under		3	....	....	1	
20/40 and under		....	2	....	2	
30/40 and under		....	....	....	1	
Over 30/40		....	....	....	3	6
No record		....	....	....	2	4

18. O. M. S. C. Status of "Improved" Cases, 9 Cases

Dry ear, hearing nil	1
Dry ear, hearing improved, but poor	4
Discharging; marked improvement of hearing	4
Total	9

19. Totals, 1252. Duplications, 11. Net total, 1241

Affections of hearing	405
Acute infections	394
Chronic infections	92
Diagnosis	95
Foreign bodies, including cerumen	243
Injuries	23
Total	1252

Section III. *Discussion of the Tables.* The total of cases is 1241 (1252 gross, 11 duplications) ears in 941 patients. The list includes, besides those presenting subjective complaints, those in whom actual ear pathology was found, but not complained of. All the cases listed have been classified as:

1. Those chiefly significant as defects of hearing.
2–3. Those chiefly significant as infectious processes.
4. Those chiefly significant for diagnosis.
5–6. Foreign bodies, including cerumen and injuries.

Ailments chiefly significant as affecting hearing numbered 405, of whom 253 commenced treatment and 141 persisted in treatment long enough to estimate results. This length of time is taken as one month, but improvement, when it occurred at all, was commonly subjectively present by the end of the first week. Twenty-one have been classified as cured. The proportion of "cure" was, therefore, but 21 cases of 141 persisting one month in treatment, or 14 per cent. Criteria of cure were: Hearing, subjectively and objectively normal; normal relations and dura-

tion of air and bone conduction; absence of tinnitus; absence of recurrence.

Fifty-one have been classified improved, or 36 per cent. Criteria of improvement were:

1. Definite and stable improvement in hearing, with or without improvement in tinnitus. As a matter of fact, improvement in tinnitus was obtained oftener than improvement in hearing.

2. Complete relief from tinnitus formerly present, with stationary hearing or slight improvement in hearing.

The total of favorable results was 72, or 51 per cent. Unimproved and progressive were 69, or 49 per cent. Favorable results varied according to the ailment treated. In the cases of chronic catarrhal otitis media the following were accepted as criteria of diagnosis:

1. Defects of hearing of conductive type, chronic in duration, without paracusis, without shortening of bone conduction and without perforations or gross scarring of the drum. The abnormalities of the drum-head noted consisted of retraction, loss of luster and increased opacity.

2. Diagnosis of chronic catarrhal otitis media was made in ears presenting:

(*a*) Characteristic changes in the drum, as just given, with tinnitus, or other subjective symptom, as fulness, warmth, but with normal hearing.

3. This diagnosis was also made in ears presenting:

(*a*) Characteristic changes in the drum, of such a degree as to be undeniable, without defect of hearing, or subjective complaint. But no such cases were treated, hence the figures as given include no "cured" or "improved" cases where diagnosis rested on such findings.

I have no doubt that this group includes some cases of otosclerosis not diagnosed as such, and I have no doubt at all that it includes a considerable proportion whose pathology is in no sense catarrhal. *X*-ray studies of catarrhal cases were instituted in the last few months of the period, and it was usual to find in cases classified as chronic catarrhal, and in whom no history of suppu-

ration was obtained, that the mastoid was sclerotic to the point that cellular structure was no longer visible. The finding occurred both in bilateral cases and in unilateral cases in which the mastoid of the unaffected side showed entirely normal structure. The suggestion as to the nature of these cases is obvious and further study will be given to it.

It is probable, also, that cases of healed otitis originally suppurative are included.

Of 108 cases of chronic catarrhal otitis media treated one month or more, 17 cases, or 15 per cent, are classed "cured," the criterion being: Total absence of tinnitus, entirely normal hearing, with normal relation of air and bone conduction 42 were "improved," 40 per cent, the total of favorable results being 55 per cent.

Table 10 shows the results obtained in the hearing of chronic catarrhal cases. Figures enclosed in brackets represent cases who remained in the same classification as to auditory acuity. Figures to the right indicate cases who progressed to a better classification. Figures to the left represent cases who progressed to a less favorable classification. Cases cited as cured are about one-half the number shown in the best bracket of final hearing. Many of the improved cases, while presenting measurable improvement in hearing, did not reach the point of a higher classification.

Of healed suppurative or cicatricial cases (Table 1), but 10 were treated, and of these but 1 could be called cured. Hearing was recorded as 8/20 at the start and 20/20 at the conclusion. The 2 recorded "improved" represents two ears of 1 patient in which hearing was normal at all times, and "improvement" consisted in complete relief from severe tinnitus. No improvement was the rule.

Six cases were considered to be otosclerosis, six ears in 3 persons. Two were treated: Both were progressive. They were so classified when hearing was severely reduced, the deafness was of conductive type, and the drum showed no visible changes, or at most a dulling of its normal luster. Paracusis was present in 2 of the 3 persons. The "rosy flush" was present in none.

Deafness of a perceptive type, substantially uncomplicated by

a conductive element, was noted in 33 cases, of which 12 were treated one month or more. Two are considered cured and 4 improved.

The results as to hearing are shown tabulated (Table 7). Two ears in different persons obtained entirely normal hearing without tinnitus, one having started at 8/40 and one at 1/40. Each of these cases was unilateral. Three "improved" ears in 2 persons reached the second bracket, having started at four feet or under; 1 remained in the second bracket, with hearing of 20/40, having started with 12/40. One "unimproved" had normal hearing, except for tone gap for watch; no change in twenty-one days' treatment. Two ears, 1 person, with normal hearing, quit after two visits. Two ears, 1 person, with 20/40 and 15/40 quit after a few visits. Of five ears which remained in the lowest bracket, 1 unilateral started with hearing "nil," and his final hearing record is "some hearing." This case was acute, following a blow on the ear. Two ears in 1 patient heard on first examination, on contact, on last examination at one foot. Two ears in 1 patient, hearing at first at 2 feet and at 6 inches, grew progressively worse during eighteen months' treatment. Favorable results are 6 cases of 12 treated.

Of 8 cases of mixed deafness, 1 improved from hearing at eight feet to entirely normal hearing, chronic catarrhal otitis media in the other ear; 1 improved from hearing at 1 foot to hearing at 8 feet, unilateral case; 1 improved from hearing at 2 feet to hearing at 30 feet, catarrhal deafness in the other ear. Favorable results, 37 per cent.

While this study was undertaken in the belief that it might show that perceptive and mixed deafness have as good a prospect of improvement as conductive cases, examination of the cured and improved cases does not show this to be the case, as 5 of the 9 ears showing favorable results were unilateral; and all that can be claimed for the nerve cases is that some will improve, and great improvement will exceptionally occur. In each of the unilateral nerve and mixed cases the final hearing in the opposite ear, normal or conductively defective, was better than in the ear in which perceptive deafness was recognized.

1. Tests of hearing by the whispered and spoken voice are reasonably reliable if the surroundings are really silent; different examiners can obtain comparable results; the space needed for such tests is considerable.

2. Ordinary means of excluding a sound ear are inadequate at short distances, and the question of hearing by the sound ear, although stopped, must be kept in mind when testing.

3. Definitely favorable results occur under treatment in about 55 per cent of chronic conductive cases, and in about 45 per cent of perceptive and mixed cases, so far as examination of a small series of cases can determine. In unilateral nerve cases the useful hearing of the patient is not likely to be increased.

APRIL 16

A Brief Consideration of Otitic Brain Abscess, with Special Reference to Diagnosis and Localization. Presentation of Cases and Specimens*

BY S. MAC CUEN SMITH, M.D.

Many of us have had the serious malady, brain abscess, under consideration and investigation for the past twenty years or more, and in spite of our study of the subject the mortality remains at about 40 per cent or higher; and were it not for the fact that a fair proportion of our cases are discovered accidentally or by sheer luck the mortality would be much greater. Today, as formerly, two chief difficulties stand as barriers to a realization of our coveted goal: The first is the serious state of patients applying for treatment, and the second is our faulty and inaccurate methods of localization. The former, the advanced illness of the patient when first seen, continues to be the chief obstacle to a lessened mortality, because the early symptoms and indications

* At a joint meeting with the Sections on Otology and Laryngology of the New York Academy of Medicine.

are not recognized as primary to an intracranial lesion. Considerable advance has been achieved in the second difficulty—localization—with indications of a progressive betterment.

The limits of this paper are necessarily so restricted that I will confine my consideration of the subject to calling attention to a few important phases, with a view of eliciting an exhaustive discussion. For the same reason I shall confine my remarks to otitic temporosphenoidal and cerebellar abscess.

The vital point that we are called upon to determine is the presence of a cerebral suppuration in its early stages, even though it may be too early to make serious effort at localization. This is quite possible even in slowly developing cases and before the evidence of compression becomes manifest.

In the *initial stage* we have headache, fever, chills or chilly sensations, and periodic vomiting. The symptoms may rapidly subside, which supports an incorrect diagnosis of acute indigestion or abdominal grippe.

The *latent stage* may continue indefinitely, but the patient does not enjoy good health. He has periodic headache, avoids exertion, shows changes in physical and mental habits, and becomes increasingly morose and eccentric, until finally, complicating some supposed general illness, he suddenly shows marked symptoms of an intracranial lesion and is ushered into the *stage of manifest symptoms*, chiefly general debility, weariness, loss of appetite and flesh, constipation, and a general feeling of malaise, and sometimes convulsions in children.

Headache is one of the most common and important symptoms, this notwithstanding the fact that the patient may have been subject to head pains. The pain may range from a dull headache to the most acute suffering, and may involve any part of the head, from the temporal region to the occiput, depending on the location of the abscess, or it may be general and have no reference to localization. If localized, it is not necessarily confined to the side of the aural infection. In only one or two instances have I been able to elicit pain on percussion, as has been suggested by some authors. In one case the headache had continued intermit-

tently for a period of several months before the chilly sensations developed, the mother believing that this headache was peculiar to the child and had nothing to do with her progressive illness, as she (the mother) had always suffered from what was termed "a woman's headache." At operation this case proved to be an encapsulated abscess.

Although subnormal temperature is distinctly characteristic of a brain abscess formation, it must be remembered that this occurs only when the process does not involve the dura. It is not uncommon to have more or less of a rise in temperature when the suppurative process works its way toward the surface and produces a localized involvement of the meninges. Later, as the process becomes walled off, the temperature will again become about normal. I have seen several of these cases where the erosive process has penetrated the dura, discoloring the tegmen tympani, and in other instances the bone itself has been absorbed, providing for ample drainage, as shown by a subsidence of practically all symptoms. In two cases we would not have suspected an intracranial abscess had it not been for the previous history. So long as the circulation is not invaded by pathogenic microörganisms, the temperature will remain about normal or even subnormal. A persistent subnormal temperature, pulse and respiration are indicative of a deep, latent abscess which has not involved the adjacent brain structure.

In the presence of an otorrhea, especially of the chronic type, the chilly sensation frequently spoken of with little thought of its significance is often the beginning of an intradural suppuration. In one of my cases these chilly sensations continued for a period of weeks, but it was noted by the patient's mother that their beginning also marked a definite change in the child's health, which grew progressively worse. On the assumption that malaria was responsible, the patient received no actual medical care until eventually a pronounced chill, lasting twelve to fifteen minutes, together with other suggestive symptoms, brought the patient to the hospital.

If the otorrhea of an otitis media becomes scanty or suddenly

ceases, and at the same time head pain and nausea or vomiting are present, we should suspect intradural pus formation. This presumption is accentuated if a morose patient suddenly becomes talkative, or *vice versa*.

During the development of an abscess the vomiting is intermittent, not severe, is usually looked upon as due to an error in diet, and does not become projectile in type until pressure symptoms make their appearance. Projectile vomiting, without relation to the taking of food, is more common in cerebellar than in temporal abscess, accompanied by subnormal pulse, temperature and respiration.

Convulsions, especially when associated with other indicative symptoms, are almost pathognomonic of intracranial abscess formation, especially in children suffering from a chronic otorrhea. In my experience convulsions are common in children, but very infrequent in adults. Disturbances of the sensory and mental state are always present. At first the patient is apathetic and drowsy, yawns, answers questions slowly and with hesitancy. Periods of alertness and clearness of mind alternating with an apparently unconscious state are followed by a failing memory, then mental dulness, ending in stupor and coma; the former may continue for some time, and this is the opportune moment for operation, before the latter—and terminal—stage intervenes. The child whose brain is here for your inspection suddenly fell to the ground in a severe convulsion while playing out of doors. Although she had had chilly sensations and suffered from headache for some weeks, this severe seizure was the real incentive that led to a recognition of the intracranial disease from which she sought relief. The abscess was situated in the temporosphenoidal lobe. A detailed report of this case follows:

Case History. R. W., female child, aged seven years. First attack of earache four and a half years ago, with spontaneous rupture of membrana tympani and prompt recovery. Three years later, complicating influenza and pneumonia, she suffered from multiple abscesses of the arms, back, right hip, and left

occipital region, which continued to drain for five months. Nine months later, December, 1922, there began severe head pain, increasing in intensity until August, or eight months, when it was relieved by spontaneous rupture of the right membrana tympani, the same ear in which spontaneous rupture took place four years previous. Associated with this were facial palsy and bulging of the right eye. For three weeks prior to entering the Jefferson hospital, in September, 1923, there was frequent projectile vomiting, and on entrance the patient was in a semiconscious state and greatly emaciated.

Operation. Mastoid operation immediately performed. Tegmen antri showed no evidence of disease. On account of symptoms a large surgical exposure of dura was made. Dura firm, not discolored. Transmitted pulsation, as though the impulse passed through a firm mass. Incision through the dura made and a large temporal-lobe abscess, containing more than two ounces of pus, evacuated.

Postoperative Progress. Patient returned to full consciousness after coming out of ether and was able to retain food. She gradually gained weight and improved in general health. Her condition was so generally satisfactory that I exhibited her to my student class, feeling that she had recovered from her brain abscess. Several weeks later there was a gradual return of lack of interest in her surroundings, and finally a sudden attack of vomiting, a convulsion, high fever and almost immediate death.

Until the acute exacerbation this patient ran a temperature ranging from normal to slightly subnormal.

The neurological examination showed palsy of the third right nerve, with slightly exaggerated reflexes on the left side.

The eye-ground showed swelling and opacity of the disc before operation, lessening considerably after operation, but the vessels remained quite tortuous. Left eye practically normal.

X-ray findings were negative.

Blood cultures, both the day before death and at autopsy, were negative.

Smear pus, removed at time of operation, showed many pus cells and Gram-positive cocci.

Cultures of pus showed Staphylococcus albus and Bacillus pyocyaneus.

Autopsy. Entire temporal lobe of brain found to be necrotic. In its central portion was a well-defined abscess cavity, 5 x 3 x 3 cm. in size.

The following brief report illustrates the expression often heard that a person suffering from a chronic otorrhea is practically living over a volcano:

C. P., female, about forty-five years of age, had had discharge from each ear practically all her life, but enjoyed excellent health. Seven months ago, after finishing her domestic duties, she went out to do the family marketing, but before reaching her destination fell unconscious to the pavement, was picked up by a policeman and taken to Memorial Hospital.

A cursory examination showed a well-nourished, apparently healthy woman, with temperature of 98°. Eyes reacted normally to light; pupils were equal and of normal size. Each membrana tympani was destroyed and the canals filled with pus.

Examination of urine and blood showed a considerable amount of sugar.

Although unconscious, the patient resisted movements of the arms, but not of the legs. There was intermittent vomiting. Reflexes were normal.

Six hours later the pupils were dilated and did not react to light. Leukocytosis, 30,000. Temperature, 102.3°. Differential not noted.

On account of the presence of sugar it was thought that the patient was in a state of diabetic coma, in the absence of all evidence of injury. She was therefore referred to Dr. Orlando H. Petty, who, during his examination, noted the discharging ears and suspected at once a brain abscess. On her way to the operating room the patient died without regaining consciousness.

Autopsy Findings. Extensive organizing clot covering the left temporal and lower central part of the left hemisphere. Localized abscess, about the size of a quarter dollar in the anterior portion of the left temporal lobe. No visible destruction of the floor of the left middle fossa about the middle ear. Diagnosis of cerebral hemorrhage of the left temporal region following an abscess of the left temporal region. Complication of the left suppurative otitis media.

In two other cases of temporosphenoidal abscess in children a long-continued headache and finally convulsions were the only symptoms noted up to the time of operation.

One of the characteristic symptoms of a developing abscess is the progressive ill health shown by a coated tongue and loss of appetite and weight. The latter is especially marked when the cerebellum is involved. Given, therefore, a case of suppurative otitis media presenting chilly sensations, headache, vomiting, changed disposition, general malaise and loss of flesh, the indications are that the patient is suffering from an intradural abscess formation. Indeed, only a few of these symptoms combined are sufficient to make us suspect the presence or beginning development of such a process and should warrant a thorough investigation.

When the symptoms are obscure, or even temporarily absent, the facial picture of one suffering from an intracranial abscess gives the impression of marked distress from serious illness.

Intracranial pressure is present to some extent in brain-abscess formations and is quite sufficient ultimately to cause a reduction in the temperature, pulse, and respiration. This should not be confused with the extreme pressure produced by tumors. The latter cause pressure by an actual increase of new tissue formation, whereas the former cause pressure at the expense of broken-down brain tissue, which necessarily must be relatively moderate in degree.

While choked disc is a characteristic symptom of intracranial pressure from any cause, and therefore not indicative of the

causative factor, its presence should be determined and considered in connection with other leads.

Optic neuritis, when present, is diagnostically helpful and may be bilateral or confined to the affected side; its absence has no significance.

I wish again to record my experience that abscess formations complicating chronic otorrhea happen much more frequently in the recurrent type. In these cases the abscess forms slowly, is usually walled off, protecting the surrounding brain structure, and may exist for a long time without attaining sufficient size to cause compression symptoms.

Generally speaking, an increased leukocytosis is a reliable index of the body resistance, while an increase in the polymorphonuclear percentage indicates the severity of the infection. However, conclusions obtained from blood counts should not be hastily accepted. Some patients become gravely ill without material increase in either, while others with a high leukocytosis and polymorphonuclear percentage are not always seriously sick.

The chief point of value is the maintenance of a relative ratio between the two, so that when the polymorphonuclear percentage is high the infection is counteracted by a corresponding increase in the leukocytosis. An increasing polymorphonuclear percentage with a falling leukocytosis is a bad omen, whereas the reverse is an indication of a favorable outcome. The leukocyte count and the polymorphonuclear percentage are usually higher in meningitis than in brain abscess or sinus thrombosis.

All varieties of organisms in pure culture or mixed infection may be present in otitic brain abscess; those most commonly found in the acute and subacute types are the Staphylococcus aureus and the Streptococcus pyogenes. The colon bacillus has been found in a majority of my chronic cases.

When localizing signs reasonably determine the presence of an abscess the area should be explored even though the dura is normal in appearance and the brain pulsates, as would be the case when the lesion is deeply situated; and it follows, *per contra*, that it is unwise to assume the non-existence of an abscess in the absence

of the dull gray dura and non-pulsating brain which are present when the lesion is near the surface.

The same principle holds true in the presence of a collection of pus between the bone and dura. If the evacuation of this extradural collection does not promptly relieve the symptoms, intradural exploration is imperative. It is quite legitimate to suspect an accumulation of pus within the cranial cavity in the presence of a profuse otorrhea not reasonably attributable to the existing tympanic and mastoid disease, even in the absence of general or localizing symptoms. I have seen several of these cases where the pus escaped through a carious opening in the tegmen tympani and was not suspected before operation.

An otitic intracranial abscess is usually situated close to the surface of the brain, in immediate propinquity to the area of diseased bone through which the infection has spread. When more deeply located the infection is not transmitted by contiguity but through the bloodvessels or lymphatics.

Should intracranial symptoms disappear following the mastoid operation and then recur, an exploratory operation is immediately indicated.

Wherever the otitic intracranial lesion may be located ultimately, I have frequently noted enlargement of the deep cervical glands as the first observable symptom. This primary glandular enlargement is usually overlooked, but is sufficiently constant as an indication of intracranial disturbance, in the presence of an otorrhea, to warrant careful consideration.

Although rigidity of the neck is one of the prominent symptoms associated with meningitis, it is also common, to a certain extent, in brain-abscess cases, since a majority of them also suffer from a circumscribed meningeal involvement.

Involvement of the fifth nerve is shown by lessening of the corneal reflex and facial hyperesthesia and that of the twelfth nerve by deflection of the tongue.

Involvement of the pyramidal tract is indicated by disturbances of the special senses of smell and taste, and a hemiplegia involving the face, arm, and leg with increasing severity, in the order mentioned.

It is well to keep in mind that otitic abscess formation is much more frequently found in the temporosphenoidal lobe on the side of the coëxisting aural disease, so we are justified in operating at this point in cases of doubtful localizing symptoms, and, furthermore, however confirmatory or even characteristic the symptoms may be, the fact remains that sinus thrombosis, subdural abscess, meningitis, and even pyemia are much more likely to be present than brain abscess, and that meningitis is the most frequent intracranial complication of an acute otitis.

In order to give the patient the best possible chance for recovery, it is essential that we should determine the exact location of the abscess formation at the earliest possible stage. The primary focus of infection is, therefore, very important in our attempts at localization. According to published records, temporosphenoidal abscess predominates over cerebellar abscess in children in the proportion of about 8 to 1, and approximately 2 to 1 in adults. As the large majority of otitic abscess formations are found in the temporosphenoidal lobe, we should first endeavor to eliminate the cerebellum. The cerebellum can be reasonably excluded if we are able to produce vertigo and past-pointing by stimulation, turning or caloric, preferably the former. The cerebellum may become involved either through the labyrinth or by way of the sigmoid sinus. It is reasonable to assume that if the labyrinth is involved the abscess formation is in the cerebellum. This is emphasized if the patient presents a staggering gait and projectile vomiting.

If our tests show the labyrinth to be intact the otogenous abscess is likely to be found in the temporosphenoidal lobe. These general principles are valuable, and yet are not definitely conclusive, and should be considered in their bearing on other manifestations.

Indications of a temporosphenoidal abscess are symptoms of compression, subnormal pulse, temperature and respiration, paralysis of the opposite side, drowsiness and aphasia when situated on the left side. In some cases, when pressure is exerted on the auditory center, there is deafness on the opposite side.

It is easy to visualize the pathology of a temporal otitic abscess when we remember the histologic changes through which a chronic mastoiditis passes. Eventually the granulation tissue and other inflammatory débris filling the mastoid cavity are converted into hard, ivory-like bone which effectually resists the erosive action of destructive pathogenic organisms, and excludes all external or cortical evidence of the underlying disease. Quite naturally the necrotic process now follows the line of least resistance and invades the interior of the skull *via* the thin tegmen antri or tegmen tympani, which fall an easy prey to the ravages of the invading micro-organisms when denuded of their mucosal lining.

Due to the fact that the temporosphenoidal lobe is the silent area of the brain, I have seen large collections of pus accumulate in this locality virtually without symptoms. Aphasia, more particularly that type which may be designated as object-naming aphasia, is one of our important diagnostic symptoms. One of my cases had object-naming aphasia when he entered the hospital. Indeed, it was owing to the fact that his parents thought that he became mentally deranged at times that the attending physician had him admitted to the hospital on the chance that his otorrhea might be a causative factor. This patient knew definitely every object that was held before him, but was unable to name any of them. He recognized a key and pointed to the door, turning his hand as though unlocking it; he indicated a knife by going through the motions of whittling; a nail-file, by indicating its use. A large temporosphenoidal abscess was evacuated, with practically immediate relief of his word-naming aphasia.

Word-aphasia in a right-handed patient suffering from a chronic otorrhea of the left side is pathognomonic of abscess involving the left temporosphenoidal lobe.

High temperature, pulse and respiration are characteristic of the acute invasive stage. In one of my recent cases these symptoms, together with severe headache, led the attending physician to suspect a meningitis in the presence of a discharging ear. In the course of two or three days all symptoms except the head pain subsided, leading to the belief that the illness was due to gastro-

intestinal disturbance. Very shortly, however, symptoms of compression, including aphasia, led to a realization that an intracranial lesion existed, which proved to be a temporal-lobe abscess.

In the absence of localizing symptoms, slow pulse and respiration and low temperature, together with a persistent headache, would lead us to suspect involvement of the right temporosphenoidal lobe.

Not any of my cases have presented "word deafness," as so admirably described by Eagleton in his recent work on *Brain Abscess*. This is true also of hemianopsia, which in all probability was overlooked on account of its transitory nature and the infrequent ophthalmological examinations, as pointed out by Eagleton.

A facial palsy which develops rather slowly, in the presence of an otorrhea, and involves the opposite side of the face, is quite characteristic of temporosphenoidal abscess, especially when accompanied by headache and repeated chilly sensations. When the extremities are involved, this also is of a progressive nature.

Recurrent attacks of stupor offer a valuable diagnostic point in the early stages of temporosphenoidal abscess. These become more pronounced and finally continuous as the expanding lesion of that lobe progresses.

The development of hallucinations of various types in the presence of an intradural lesion, of which much has been written, indicates involvement of the temporosphenoidal lobe. As compression increases the mentality markedly changes, slowness of speech and comprehension are replaced by heedlessness or mental aberration. Periods of somnolence may suddenly change to a state of mental excitation simulating delirium.

Cerebellar abscess is much more difficult to diagnose, especially in the early stages, than is an abscess of the temporal lobe. I remember seeing, many years ago, the postmortem findings of a case of destruction of the cerebellar hemisphere, which came under the care of a general surgeon, in which practically no localizing symptoms were present. As before stated, early manifestations are frequently observable in temporosphenoidal abscess, but

symptoms that are more or less characteristic of cerebellar abscess commonly do not occur until pressure symptoms show themselves, such as vertigo, paralysis of the face and extremities of the same side, projectile vomiting, staggering gait, spontaneous pointing deviation, spontaneous vertical nystagmus, falling, and lateral deviation of the eyes.

Bárány has pointed out that if there is rotary nystagmus toward the affected side and no longer any irritability of the labyrinth, one can be reasonably sure of the existence of a cerebellar abscess, provided the patient has a slow pulse and low temperature. As the disease progresses nystagmus gradually increases and is always more marked toward the affected side.

If symptoms of intradural suppuration are present and tests reveal a dead labyrinth or the presence of a lateral sinus thrombosis, the indications are in favor of the abscess being located in the cerebellum. The patient is inclined to fall toward the opposite side from the lesion, and this, with optic neuritis, will serve to differentiate this condition from internal ear suppuration, in which the gait is of a swaying or staggering character, without optic neuritis.

We must recognize that the stimuli for muscular coördination and tonicity originate in and are controlled by the functional activity or inactivity of the cerebellum. Therefore, any deviation from the normal, such as muscular paralysis (which, however, would not be complete unless the pyramidal tract was involved), would indicate cerebellar involvement.

In a male patient, aged about thirty-five years, I noted a rapid loss of flesh, together with an absence of the patellar reflexes and very frequent projectile vomiting, all of which disappeared in due course on evacuation of the cerebellar abscess.

Satellite abscess formations are not infrequent. Those which have come under my observation at postmortems did not communicate with the parent abscess, and in all probability were the cause of the death, as under some circumstances a fatal issue is not dependent on the bulk of the abscess.

However important it is to operate at as early a stage as pos-

sible, we must keep in mind that during the progress of advancing softening the formation of pus will not yet have occurred, and it will be most unwise to attempt evacuation at this time. The difficult point is a proper recognition of just when an abscess formation is complete, and at the same time this clear conception of its development is most important, as above stated.

Great stress is often placed upon the presence of optic neuritis, which may be found in a few days after the onset of the illness; in other cases, it does not appear until the disease is well advanced. If we are reasonably convinced of the presence of a lesion we should not wait for the appearance of optic neuritis.

The very best time for surgical intervention is during the early purulent stage, when the high fever and severe general headache have largely subsided and the stages of stupor and irritability have been replaced by the sleepy state, where cerebration is slow, the intellect dull, and the temperature and pulse are just about normal, with pupillary inequality. Any delay after this favorable time for operation lessens the patient's chances of recovery in increasing degree. To wait for the arrival of the toxemic or paralytic period, when pupils may be either dilated or contracted and deep coma ensues, offers the patient poor chances of recovery, even in the hands of the most skilful operator. Unfortunately, this is the stage in which many cases are received, and this adds largely to our mortality percentage.

We must always be cautious in our statements as to the permanent cure of a patient suffering from an abscess in any part of the brain. Even so, one of my patients, a child aged nine years, in whose case I evacuated pus from the temporosphenoidal, then the cerebellar, and finally from the frontal lobe, was operated upon in 1909, more than fifteen years ago. This case was reported in the *Laryngoscope*, August, 1910. She is now in normal condition, mentally and physically, and is married and the mother of two healthy children. She is here for your inspection this evening.

Another patient, a male, aged thirty-seven years, was also operated upon in March, 1909, and a temporosphenoidal abscess evacuated. He enjoys excellent physical and mental vigor today and is present for examination.

A third case is that of an adult, aged forty-two years, from whose brain I evacuated a temporosphenoidal abscess twelve years ago. He is a hard-working man and enjoys good health. He is present tonight.

A fourth brain-abscess case was operated upon seven years ago. She made a good recovery, has continued well and is present tonight. Her history has not been published and is given below:

M. W., female, aged thirty years. Admitted to hospital June, 1917. Five weeks before admission the patient had pain in the right ear for several days, followed by spontaneous rupture of the membrana tympani. At the end of this period the discharge suddenly ceased, with almost immediate swelling over the mastoid process. The usual routine examinations were negative, with the exception of the ear.

At operation a carious opening was found over the cortex. The cells were completely destroyed and the cavity filled with pus and some granulation tissue. Medium-sized perisinus abscess. Nothing in the tegmen antri or tegmen tympani to indicate any intracranial lesion. Postoperative temperature for six days, 99° to 100.2°; then normal. Patient left the hospital twelve days after operation, apparently in good condition.

Three weeks after mastoid operation she was readmitted to the hospital, suffering from headaches and vomiting after meals. Attacks of vertigo when walking, with tendency to fall toward the affected side. An examination of the ears was negative, but there was some swelling of the deep cervical glands on the right side and a moderate but progressive loss of flesh. Patient was in a semi-comatose state, talked irrationally, with convulsive movements of the extremities and a widely dilated right pupil, the left being normal. Some redness over the scar of previous mastoid operation. Otherwise examination was negative.

At operation the tegmen tympani was discolored, and when removed revealed a bulging and tense dura. On incision about 4 ounces of greenish-yellow pus was liberated, the abscess cavity being from 2½ to 3 inches deep. At the time of the patient's

second admission the temperature was at all times either normal or subnormal, and so continued throughout the progress of her recovery.

Some time after the second operation this patient suffered from convulsive movements, which were pronounced not to be Jacksonian in type. She has now completely recovered. I regret that the laboratory reports in this case have been mislaid and are not available for record.

This patient is present for your inspection.

I believe we can reasonably say that these four cases have permanently recovered. On the other hand, some of my brain-abscess cases have died suddenly, some time after operation, in what were termed convulsions, presumably from a refilling of the pus sac, or an existing satellite abscess, which may have ruptured into the ventricles.

I am indebted to Dr. Lewis Fisher for the detailed report of the three cases following, in which it was his good fortunte to obtain Bárány tests prior to operation. Not any one of these cases presented symptoms of an intracranial lesion other than the Bárány reactions.

Case I.—C. F. Chief complaint, discharge from the right ear. Dizziness, first attack two years ago, last attack two weeks before examination. Patient able to work. No other symptoms.

Examination showed a chronic purulent otitis media on the right side, with large central perforation. Total deafness. Hearing was good in the left ear and appearance normal.

Vestibular examination revealed no spontaneous phenomena deviating from the normal. Turning tests showed nystagmus after turning to the right and left of twenty-four and twelve seconds, respectively, suggesting a non-functioning right horizontal canal. The vertigo was diminished, but past-pointing was especially poor, the left arm persistently pointing in the wrong direction. The caloric test showed that the entire right ear was practically non-functioning. The left, when douched, showed no

response whatsoever for the vertical semicircular canals, but a good, active response for the horizontal.

The patient was advised to enter the hospital, but refused, insisting he was not sick and would like to continue with his work.

He appeared for another examination a month later and findings were substantiated at same, with the exception of vertigo after turning, which was considerably diminished, and the right ear, previously non-functioning, did show some trace of responses this time. Patient was again advised to enter the hospital and again refused.

The complete neurologic examination carried out the same day was entirely negative.

Three weeks later the patient was brought into the hospital in a semiconscious condition and died the same night.

Autopsy revealed an abscess in the cerebellum on the right side.

Autopsy. This patient showed no clinical signs indicating such a grave lesion. The vestibular examination was the only means of suspecting the true condition. The absence of responses from the vertical semicircular canals, but good response from the horizontal canal on the left side (the good ear), definitely indicated a central lesion. The interference with vertigo and past-pointing further suggested that involvement was probably cerebellar. The abscess was deep in the substance of the cerebellum and could not have been found at any ear operation, had one been undertaken simply on account of the suppurating ear.

Case II.—W. M., male, aged forty years. Examination, April 13, 1923. Patient complained of headache for the last seven or eight years. Recently slight vertigo. Suppuration in the left ear since childhood. Examination showed practically a normal-looking right ear, with good hearing. Left ear showed a chronic purulent otitic process, with drumhead gone, the pus fetid and profuse. Hearing quite good. No spontaneous phenomena referable to the vestibular mechanism. Station good. Pelvic girdle movements good; pointing tests performed accurately.

Turning to right and left showed good nystagmus, vertigo and past-pointing. Douching the right ear showed a delayed response from the right vertical semicircular canals. The nystagmus came on very suddenly, in an explosive manner. From the horizontal canal, large, active nystagmus.

Douching in the left or suppurating ear showed prompt and active response from the vertical semicircular canals, but markedly perverted nystagmus from the horizontal; that is, on tipping the head back the nystagmus, instead of being in a horizontal plane of the head, was vertical and markedly oblique.

We considered the findings indicative of intracranial involvement because the left horizontal canal produced such a markedly perverted nystagmus and the vertical canals of the right, or good ear, showed a much delayed response, but one that was marked when it finally did appear. There was hardly anything else to point to a central lesion. There was no choked disc, no palsy of any of the cranial nerves, no weakness of any of the muscles, no sensory disturbances, no ataxia or adiadochokinesia, no fever, and no mental symptoms. We considered the vestibular phenomena referred to as sufficiently definite to make a diagnosis of central involvement. The suppurating ear naturally pointed to a brain abscess as being the most likely lesion. Good vertigo and past-pointing after turning excluded the cerebellum, leaving the temporal lobe as the other most likely site for such an abscess.

Operation several days later showed the presence of a large abscess in the temporal lobe.

Case III.—F. L. Reported by Lewis Fisher in *Equilibrium and Vertigo.* Patient had been suffering from headaches and came to the hospital for examination to ascertain whether a previous ear operation on the right side was in any way responsible. Two weeks previously he was taken suddenly ill and had no recollection of what happened, except that he recovered consciousness in the hospital. Improved in a few days and was discharged practically well, except for occasional headaches.

Examination revealed that some mastoid surgery had been done

on the right side. Hearing in that ear was fair. Left ear entirely normal. No spontaneous phenomena deviating from the normal. On douching the vertical semicircular canals on both sides failed to respond, while the horizontal canals responded well. This strongly suggested an intracranial lesion. There was very good past-pointing of both arms to the left, after turning to the left, suggesting that the trouble was probably not in the cerebellum. Patient advised to go to hospital, but refused.

A week or two later the patient again became unconscious suddenly and was rushed to the hospital. The operated ear was again operated upon, without discovery of anything definite intracranially. Neurologic examination entirely negative.

Patient died shortly after, and the autopsy showed a large abscess in the temporal lobe which ruptured into the ventricles, filling the entire ventricular space with pus.

In this case no diagnosis of intracranial lesion could be made on the general clinical phenomena, or, what is more important, even a thorough operative exploration failed to reveal the true condition. The vestibular examination alone indicated intracranial mischief.

Summary. The use of the vestibular tests in the diagnosis of brain abscess may be summed up as follows: They are useful in that frequently they are the only tests that indicate with any degree of definiteness the presence of intracranial involvement. There is nothing about them that would directly suggest an abscess, but what they do indicate is the presence of increased intracranial pressure.

Given a case of unoperated aural suppuration or one where the operation has been performed and the patient is not doing just right, the finding of a spontaneous vertical nystagmus or of a loss of responses from the vertical semicircular canals, without such a loss from the horizontal canal, or of a perverted nystagmus after douching, etc., at once leads us to suspect very strongly the presence of some intracranial lesion. When the general clinical picture and laboratory tests exclude everything except brain abscess,

the vestibular examination might indicate whether such an abscess is in the cerebellum or temporal lobe. The ability to elicit vertigo and past-pointing after stimulation will eliminate the cerebellum and suggest the temporosphenoidal lobe as the probable site of the trouble.

Inasmuch as intradural suppuration does occur without indicative manifestations, it is a wise precaution to determine the labyrinthine reactions prior to all mastoid operations for the relief of a chronic otorrhea, as sometimes, as illustrated by the above cases, the Bárány tests give the only clue to an intracranial lesion.

Treatment of Paralysis of the Recurrent Laryngeal Nerve by Nerve Anastomosis

BY CHARLES H. FRAZIER, M.D.

(Abstract)

The question of relief of paralysis of the recurrent laryngeal nerve was brought to the attention of Dr. Frazier by Dr. Chevalier Jackson in January, 1923. Up to that time Dr. Jackson had been endeavoring to provide a measure of relief for the embarrassed respiration, in some instances necessitating the introduction of a tracheotomy tube as an emergency measure, by dilatation of the glottis with bougies and by a ventriculocordectomy, in which Dr. Jackson removes all of one vocal cord and the adjacent ventricular floor anterior to the vocal process. This ingenious method admits on inspiration, an adequate supply of air, thus dispensing with the tracheotomy tube; but it does not restore the flexibility of phonation, and the patient for a long time is unable to talk except in a whisper. The shortcomings of this palliative endolaryngeal operation prompted Dr. Jackson to consider other methods of relief, and at this juncture our conjoined efforts began.

A study of the problem in the anatomical laboratory revealed to the writer the possibility of a nerve anastomosis or nerve suture between the descendens hypoglossi and the peripheral stump of the recurrent laryngeal nerve. The descendens hypoglosssi seemed quite ideal for the purpose from various standpoints: First, because of its accessibility; second, because it was almost purely a motor nerve; third, because it could be sacrificed without harmful consequences; and fourth, because it was more or less allied in function physiologically to that of the recurrent laryngeal nerve.

Inasmuch as the majority of cases had been brought to Dr. Jackson's attention with bilateral recurrent laryngeal paralysis, which had followed operations on the thyroid gland, it was assumed in most instances that the recurrent laryngeal nerve had been damaged at or above the level of the isthmus. In the development of the technic for exposure of the nerve it became necessary to find a means of isolating the nerve at some point between the upper level of the isthmus of the thyroid gland and the point at which the nerve disappears behind the inferior constrictor of the pharynx. The anatomical guides to the location of the nerve that have proven of service are the inferior cornu of the thyroid cartilage and the inferior constrictor muscle of the pharynx. Even with these definite landmarks and a clear understanding of the relationship of the recurrent laryngeal nerve to them, its exposure at the operations which we have thus far performed has been one of considerable difficulty. This is due to the fact that, following thyroidectomy, there is more or less cicatricial tissue at the site of the operation which obliterates normal anatomical planes and masks normal anatomical structures. Thus far, with one exception, we have been able to expose the nerve and effect a satisfactory approximation. The indications for operation are quite clear and distinct. It should not be undertaken except in those cases in which there is total paralysis of one or both vocal cords. In one case in which Dr. Jackson reported that there was a certain amount of tonus in the cord, it seemed unwise to divide the recurrent laryngeal nerve, and in this case a lateral implantation was substi-

tuted; but in all others an end-to-end approximation has been made between the central segment of the descendens hypoglossi and the peripheral segment of the recurrent laryngeal. Sufficient time has not yet elapsed for the final results to be recorded, but at the present time there has been definite evidence of return of function in the first two patients operated upon to warrant repetition of the operation

As to contraindications, one must be certain before the operation is undertaken that there is free motility of the cricoarytenoid joint, since in cases of fixation of the joint it would be hopeless to expect any motility to be restored no matter how perfectly anastomosis might restore innervation. According to Dr. Jackson, the best methods of determining the degree of motility of the cricoarytenoid joint is by making passive motion with the laryngeal forceps used through the direct laryngoscope.

The writer is under many obligations to Dr. Jackson for his constant coöperation and stimulating influence in the development of this operative method of dealing with paralysis of the recurrent laryngeal nerve. We must regard this in the nature of a preliminary report until sufficient time has elapsed for the maximum benefits of the operation to have been made manifest.

Severing the Palatoglossus with the Galvanocautery as a Preliminary to Cryptotomy in Selected Cases of Chronic Tonsil Sepsis*

BY GEORGE FETTEROLF, M.D., SC.D.,

AND

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(By invitation.)

Introduction. Every now and then a patient will appear whose tonsils should be removed, but in whom tonsillectomy is

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contraindicated on account of that patient's being a bad operative risk, or else the operation is refused by the patient from motives of fear. It is the existence of this group which has caused to be used such measures as fulguration, crypt-slitting, *x*-raying, expoure to radium, etc. Of these *x*-raying has been pretty well discredited, exposure to radium is still *sub judice*, and fulguration and crypt-slitting are completely effective only in the protuberant tonsil. While these cases are fewer in number than before tonsillectomy under local anesthesia became an established procedure, there are still enough of them to make it desirable that we have a satisfactory alternate procedure.

The purpose of the present paper is to submit a technic which has proved to be quite efficacious and in which galvanocauterization is the procedure used. The method consists of severing the palatoglossus muscle, thus completely exposing the tonsil, and the laying open of the crypts one by one.

Is the Palatoglossus of Any Value? The question immediately arises as to whether or not this muscle can be cut with no resulting impairment of throat function. In man the palatoglossus is such a slender strand, and its importance would seem to be so slight, that the thought naturally occurred that in some of the lower mammals it might be of great value and in man only vestigial. With this idea in mind we searched the literature of comparative vertebrate anatomy for information on this point and made dissections in available lower mammals with the following results:

The Palatoglossus in the Lower Mammals and Other Vertebrates. In the fishes there is no velum palati nor are there tonsils. In the reptiles the mouth gives passage to respiratory as well as to food currents, the crocodile family alone of this group having a soft palate. In birds the posterior nares are undefended by either soft palate or uvula, this probably explaining why animals of this group raise their heads when drinking. Neither Owen,[1] Offel,[2]

[1] Lecture on the Comparative Anatomy and Physiology of the Vertebrate Animals, delivered at the Royal College of Surgeons of England in 1844 and 1846.

[2] Lehrbuch der Vergleichenden Mikroskopichen Anatomie der Wirbeltiere, 1896. Band ii.

nor Allen,[1] in their extensive works on comparative anatomy, describe the palatoglossus as existing in birds, reptiles and fishes.

Even in the works on the lower mammals accurate descriptions of this muscle are not found. Strangeways,[2] in speaking of the horse, says: "If this muscle exists in the horse it will be found under the mucous membrane of the anterior pillar, which it helps to form, thus joining the soft palate and the tongue." Sisson,[3] in a comprehensive and thorough work upon the anatomy of domestic animals makes no mention of the palatoglossus muscle in the horse, ox, pig, sheep or dog. Similar omissions are made by various other writers, among whom are Reighard[4] and Jennings[5] and Wilder and Gage.[6] All of them mention the anterior faucial pillars, but refer to them merely as folds of mucous membrane.

Authors' Investigations. Our own studies on the anatomy of the palate-tongue region of the lower mammals comprise dissections of this region in the dog, cat, mouse, rabbit and guinea-pig.

In the dog the faucial tonsil lies about one-half inch posterior to the point where the mucous membrane of the maxilla swerves downward to join that of the mandible. It is bean-shaped, with its long axis horizontal. The superior surface is covered by a fold of mucous membrane, which contains muscle fibers and forms an arch between the anterior and posterior pillars. The anterior pillar is by no means an obvious structure, and in the hardened specimen is rendered visible only by exerting traction upon the tongue or by widely separating the jaws. If this be done there can be seen anterior to the tonsil a membranous fold containing some striæ, probably muscle fibers, having as its termination the soft palate above and the lateral margin of the tongue below. Dissection of both fresh and formalinized specimens failed to demonstrate any well-defined muscular bundle.

[1] Outline of Comparative Anatomy and Medical Zoölogy, 1869.
[2] Descriptive Anatomy of the Horse, 1870.
[3] The Anatomy of the Domestic Animals, 1914.
[4] Anatomy of the Cat, 1901.
[5] The Cat: An Introduction to the Study of Backboned Animals, Especially Mammals, 1911.
[6] Anatomical Technology as Applied to the Domestic Cat: An Introduction to Human, Veterinary and Comparative Anatomy, 1886.

The faucial pillars in the cat are formed by two mucous membrane folds passing from the soft palate to the tongue, their direction diverging as they pass downward. Here, too, traction must be exerted upon the tongue in order to make visible the anterior pillar. Its structure is delicate and the amount of muscle tissue scant.

Neither the mouse, the rabbit, nor the guinea-pig upon macroscopic dissection shows any well-defined palatoglossus muscle. In fact, in these animals it is difficult to accurately determine the site of the tonsil, and the faucial pillars, too, are by no means obvious.

The investigations which so far we have been able to make in mammalia have not, as we hoped, revealed any species possessing a palatoglossus of notable proportions or development. If a well-developed and obviously functionating palatoglossus muscle does exist in any of the mammalian species not examined by us it has escaped the notice of many careful investigators. It would be interesting and worthwhile to carry this investigation further and study many more species, but at the present time material is not available for such study.

The Palatoglossus in Man. Although all of us are familiar with the general characteristics of this muscle as found in the human being, it may be of value to quote the description of it given by Gray:[1] "A small fleshy fasciculus, narrower in the middle than at either extremity, forming with its mucous-membrane covering the anterior pillar of the fauces. It arises from the anterior surface of the soft palate on either side of the uvula and passing downward, forward and outward in front of the tonsil is inserted into the side of the tongue, some fibers passing to the dorsum, others passing deeply into the substance of the organ to intermingle with the transverse lingual muscle fibers. In the soft palate the muscle fibers are continuous with those of the opposite side."

In our own dissections of this muscle, using formalinized specimens, our findings coincide in general with the description given above. It is debatable, however, just how much tissue is con-

[1] Anatomy, Descriptive and Applied, 1918.

tinuous from one side across the raphe of soft palate to its fellow of the opposite side. In our specimens the fibers upon entering the soft palate structure retained their identity as a muscle fasciculus for only a very short distance, after which they spread out in a fanlike manner to terminate in the palatal tissues. Only the most central fibers of this fan could be demonstrated as reaching the median line and none as passing to the opposite side. At the lingual extremity, the muscle divides into two main trunks. One passes deeply into the tongue substance to mingle with the transverse fibers: the other, more superficially placed, joins with the muscle fibers passing longitudinally along the edge of the tongue. In a previous investigation it was found by one of us (Fetterolf)[1] that *in situ* the muscle has the form of a three-sided prism, or, on cross-section, of a low isosceles triangle, the base of which faces the oral cavity. (Fig. 1).

Clinical Considerations. From the clinical standpoint it is the lacunæ that cause the tonsils to be so harmful. These crypts are either simple or compound, and they vary greatly in width, depth and complexity. They may have wide ostia or narrow ostia. They may have two or more ostia. They may be single at the surface and branched in their deeper parts. They may open on the surface or they may open into a central cavity, which in turn opens on the surface.

Now, if the tonsils were thin, flat, cryptless areas of lymphoid tissue, like Peyer's patches in the small intestine, for example, they probably would cause infinitely less trouble, possibly even much less than does the lingual tonsil. It is probable, therefore, that if the faucial tonsil could be converted into a flat, cryptless mass there would be no pus retention in the crypts, no chronic infection of the lymphoid tissue and no absorption therefrom into the general system. Granting this to be true, an operative procedure which would lay all the crypts wide open ought to be an acceptable maneuver in those cases which cannot be tonsillectomized.

[1] The Anatomy and Relations of the Tonsil in the Hardened Body, with Special Reference to the Proper Conception of the Plica Triangularis. The Principles and Practice of Tonsil Enucleation as Based Thereon. Am. Jour. Med. Sci., July, 1912, No. 1, vol. cxliv.

Crypt-slitting as a palliative measure has been practised for years. It is an old and well-established procedure, and its use in selected cases has recently been ably championed by Swain.[1] Severing the palatoglossus also has been advocated, but we have found only two references bearing on this feature. In one article Paterson[2] mentions the horizontal slitting of the superior tonsil fossa and of the anterior pillar with a bistoury as practised in Hunsberg's clinic, and in the second the sanctity of the palatoglossus is routinely violated in a method of tonsillectomy recently advocated (1923) by two French writers, Mouret and Cazejust.[3] These authors sever the palatoglossus and palatopharyngeus muscles as the first stage of a tonsillectomy. Operating in this manner they state that there has not been "the slightest immediate or late hemorrhage. The staphylotomy leaves no cicatrix or speech defect. Coaptation of the lips of the incision occurs in a week."

The procedure herewith presented is therefore original only in that a combination of the palatoglossus myotomy and tonsil cryptotomy performed with a galvanocautery point has not hitherto been presented.

Accessibility of the Tonsil to Cryptotomy. There are few, if any, tonsils whose anterolateral portion is not covered by the anterior faucial pillar. All of us have examined many throats in which retracting of the anterior pillar has been necessary before any part of the tonsil could even be seen. Yet it is tonsils of this type which we often need to eliminate, and it must be obvious that to reach the bottom of the crypts, with no preliminary exposure of the tonsils, would be impossible. It follows, therefore, that in order to open widely every crypt to its full depth, free access to the anterior surface of the tonsil is necessary. This cannot be attained without severing or dissecting back the palatoglossus. Cautery dissection is impractical, and cold dissection, as a preliminary to cautery-slitting of the crypts, would result in so

[1] Must it Always Be Tonsillectomy? Trans. Am. Laryngol. Assn., 1921, xliv, 63.

[2] The Significance of the Tonsils and the Supratonsillar Fossa, Jour. Laryngol., Rhinol. and Otology, September, 1913, xxvii, 453.

[3] Maximum or High Tonsillectomy: Definition, Indications, Operative Technic, Ann. d. Mal. de l'Orielle, du Larynx, etc., Paris, September, 1923, xlii, 845.

covering the field with blood as to prevent accurate opening of each crypt to its full depth. The plan of severing the palatoglossus was therefore adopted, but with a certain amount of misgiving as to the possible bad palate functioning afterward. This fear proved to be groundless, for in no patient on whom this operation was performed did any subsequent disagreeable symptoms develop. The effect on the voice of a trained singer cannot be stated, as this maneuver has not been attempted in the throat of any such.

The technic is very simple. The anterior pillar and the accessible crypts are anesthetized with cocaine applied locally. The anterior pillar is then severed with a cautery knife. Fig. 2 shows the point at which to sever the muscle with the best resulting contraction and tonsil exposure. As a result of the muscle-severing, the two ends retract from each other to the extent of several centimeters. After the muscle has been cut through, no matter how deeply situated the tonsil is, its rounded anterior surface is exposed to its full width, as shown in Fig. 3. Then one crypt is identified in direction by a bent probe and slit to its depth with a cautery knife. Then a second, and so on. It is quite amazing to note how easy it is to follow any given crypt to the bottom without the operator having to work around a corner or use a retractor to hold out of the way any intervening tissue.

Only two cautery points are necessary, and they should be well insulated all the way to the iridoplatinum tip. This is necessary because the shaft necessarily touches at times the lower lip, the teeth or the tongue, and this contact is usually more complained of than is the burning by the cautery. Of the two tips one should be thin and flat, a knife, in fact, for cutting laterally or up or down, and the other with a probe-like point for reaming out those crypts which run backward.

For the operator to finish with a clear conscience he must feel assured that every crypt has been opened to the bottom and that the tonsil lies broad and flat before him with perhaps a few shallow pits on the surface. (Fig. 4). We have found that crypts need to

be followed in one or all of four directions, viz., upward, laterally, downward and backward. A not uncommon experience is to open into a large central cavity immediately behind the plica and then to see extending in different directions secondary crypts whose existence could only have been suspected.

Pus under pressure which flooded the operation area when the crypt was entered has been encountered twice, and in both cases

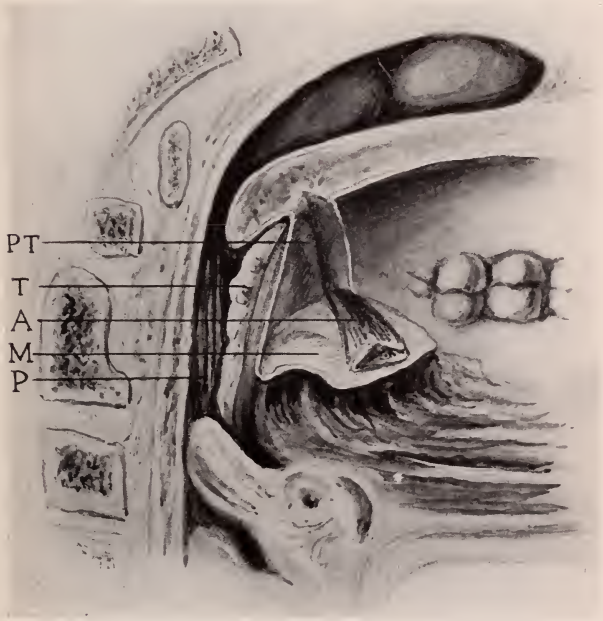


FIG. 1.—Left faucial region with mucous membrane and palatoglossus muscle, reflected downward: *M*, reflected mucous membrane; *A*, palatoglossus; *PT*, plica triangularis; *T*, tonsil; *P*, palatopharyngeus.

from a crypt which extended laterally and upward. One of these was in a case of acute iritis and the other in a case of recurrent eczema.

Bleeding has in several instances caused interruption of the operation, either for a few moments or for that session. In one instance it was necessary to clamp the bleeding vessel with a

hemostat, which was left on for half an hour, after which there was no trouble.

No local or general septic reactions have occurred and in this connection two points of at least theoretical value are that the raw cauterized surface has been thoroughly sterilized by the heat of

Fig. 2.—This illustration shows the best point at which to sever the palatoglossus. The tongue is shown depressed on the left side.

the cautery and that no squeezing or other force will have driven any microörganisms into the tissue underlying the burned area.

Quite a noteworthy fact is that after the area healed there was present anterior to the tonsil an uninterrupted arch parallel with

the mesial edge of the original anterior pillar, but situated markedly lateral to it.

At the point of the galvanocautery division of the muscle there would sometimes be seen, after healing, a fibrous area, but with very slight or no cicatricial puckering. Back of this would lie a

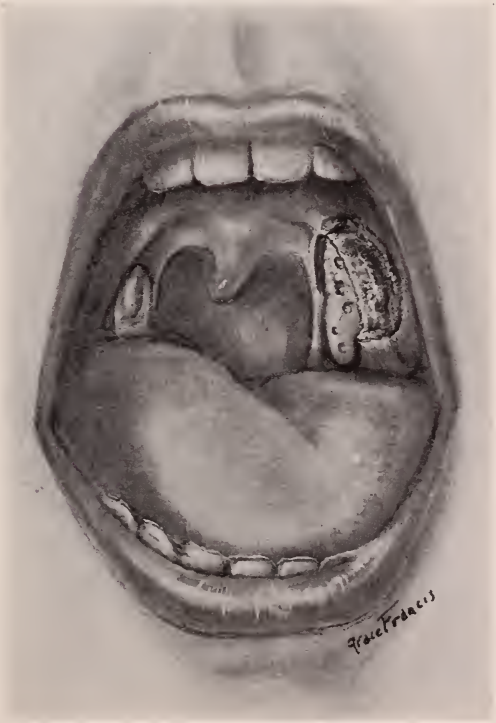


Fig. 3.—This illustration shows the extent to which the severed ends of the palatoglossus retract, thus exposing the entire anterior surface of the tonsil. The left side of the tongue has been depressed.

more or less flat poultice of lymphoid tissue with no crypts, but at times shallow dimples, indicating the deepest part of the opened crypts.

Results. It can be stated, with fairness, that the results are approximately as good as if the tonsils had been removed. There

have been brilliant successes in cases of arthritis, iritis, etc., and and there have been notable failures. The same can be said of tonsillectomy.

Fig. 4.—This illustration shows the cauterization completed with the tonsil lying as a flat superficially fitted mass with the anterior pillar lying lateral to its former position.

Conclusions. It is obvious that this method needs further and extensive trial before final judgment can be passed upon its value. But this much is true: It has no contraindications, except a degree of youthfulness of the patient which would prevent coöperation; it does not incapacitate the patient for business; it frequently produces brilliant results, and so far it has proved to be free of dangerous sequelæ.

The Septum-Ethmoid Complex in Relation to Chronic Catarrhal Otitis Media

BY JAMES A. BABBITT, M.D.

The title "septum-ethmoid complex" has perhaps been appropriately selected to clothe a new avenue of approach to a time-honored field of otorhinologic research, and one often relegated by investigating groups to as hopeless finality as Metchnikoff's deferment of old age and the control of alopecia. Indeed, the analogy may be too precise, and the rather hopeless and unattractive field of chronic catarrhal otitis media may be inevitably so. The work, however, presented by Fraser on ear pathology, Bordley on intratubal treatment, Emerson, Pemberton and others on focal infection, the splendid advances in allergic science and audiometric measurements, the records of a host of others in the cumulative results of patient clinical routine, must stimulate the belief that something of increasing value will soon come to relieve the vast army of insidiously deafened ears, for which we still afford but little relief. This paper will briefly consider again the intra- and postnasal influences in contribution to tubal obstruction of catarrhal otitis media and open again the discussion as to justifiable aid in the restoration of normal air currents.

Certain fundamental facts would seem to obtain: 1. The etiologic factors in middle-ear deafness form a complete syndrome involving physical, physiologic, pathologic and perhaps psychic influence.

2. The process is insidious, both in onset and progression, and its study, to be of value, must be upon subject material during a still formative, perhaps, preventive stage—groups of patients not far abnormal. If advanced pathology be once established its service is merely one of partial repair and retardation.

3. The extra-, intra- and postnasal diagnostic picture in a multitude of patients suggests a vitiated respiratory channel and raises the query of potential liability. To be frank, has the

oft-abused expression "suction pull in the fossæ of Rosenmüller" any proved basis in fact?

4. The relation of cause and effect of abnormalities in the picture is not at all established. In the triumvirate—septal deformity, turbinate degeneration and postnasal block—the priority of influence is often but a matter of opinion, and in the septum at least involves embryologic, developmental and traumatic factors. In these days the fallacy of removing tonsils simply for cure of deafness is well established, but one might note, parenthetically, the surgical roster still attests the rapacious appetite for tonsil collection.

5. While the *x*-ray findings as well as laboratory culture for focal infection are subject to wide variation in interpretation, and the personal equation is important, in composite review of a large number of these, one is impressed with the exudative evidence in the ethmoidal area and its coördination with septal pressure. Is not this a more important factor than is usually rated in the development of lymphatic hyperplasia in the pharyngeal end of the tube?

6. The economic efficiency significance of the "deafened" problem, unless one submits to the Osler dictum, has not met the parallel attention accorded tubercular, malignant, specific, ophthalmic and allergic problems. If recent investigations suggest more optimism, concerted effort is demanded for widespread survey of the deafness status, uniform criteria of measurements and tests and establishment of preventive measures in the educational age. This is up to the otolaryngologists, who alone can accomplish it.

For the purpose of this paper, three groups will be considered:

(1) Patients operated on for relief of tubal trouble in whom the septum-ethmoid complex seemed a justifiable factor; (2) nonmedical subjects selected for purposes of analyzing the correlation involved in an intranasal picture of undue septum-ethmoid proximity, and (3) a few selected *x*-ray plates from a series taken by one operator, which demonstrated septal-ethmoid inter-action, all but one of whom were justifiably operated upon (this one somehow

escaped and was operated on elsewhere). Dr. Pfahler, who took this series in course of routine examinations, and with no relation to their demonstration, will present lantern slides of plates in question.

I. The writer has felt for some time that in a case of election to relieve an upper nasal involvement the surgery should, of choice, be septal. A well-operated septum, with proper drainage and properly preserved flaps, ought to be unattended by danger and leave a comparatively normal anatomy, and experience seems to have shown that a certain percentage of troubled ethmoid areas will return to normal drainage when pressure is removed and air current reëstablished. Certainly, a well-healed septum presents a better picture than a mutilated turbinate base and less offensive crusting. In comparison of septum and ethmoid operations of all kinds and degrees, the former approximating 1000 operations, the only two intracranial complications were ethmoidal. The comparison, however, is hardly fair, as these two were *in extremis*.

The case records represented three types: (1) Cases of simple stuffiness of tubes; retracted tympani with occasional periods of tinnitus; (2) those of marked general deformity, internal and external and (3) those of ordinary septum-ethmoid complex associated with advancing tubal obstruction, deafness and tinnitus, practically disabling the patient.

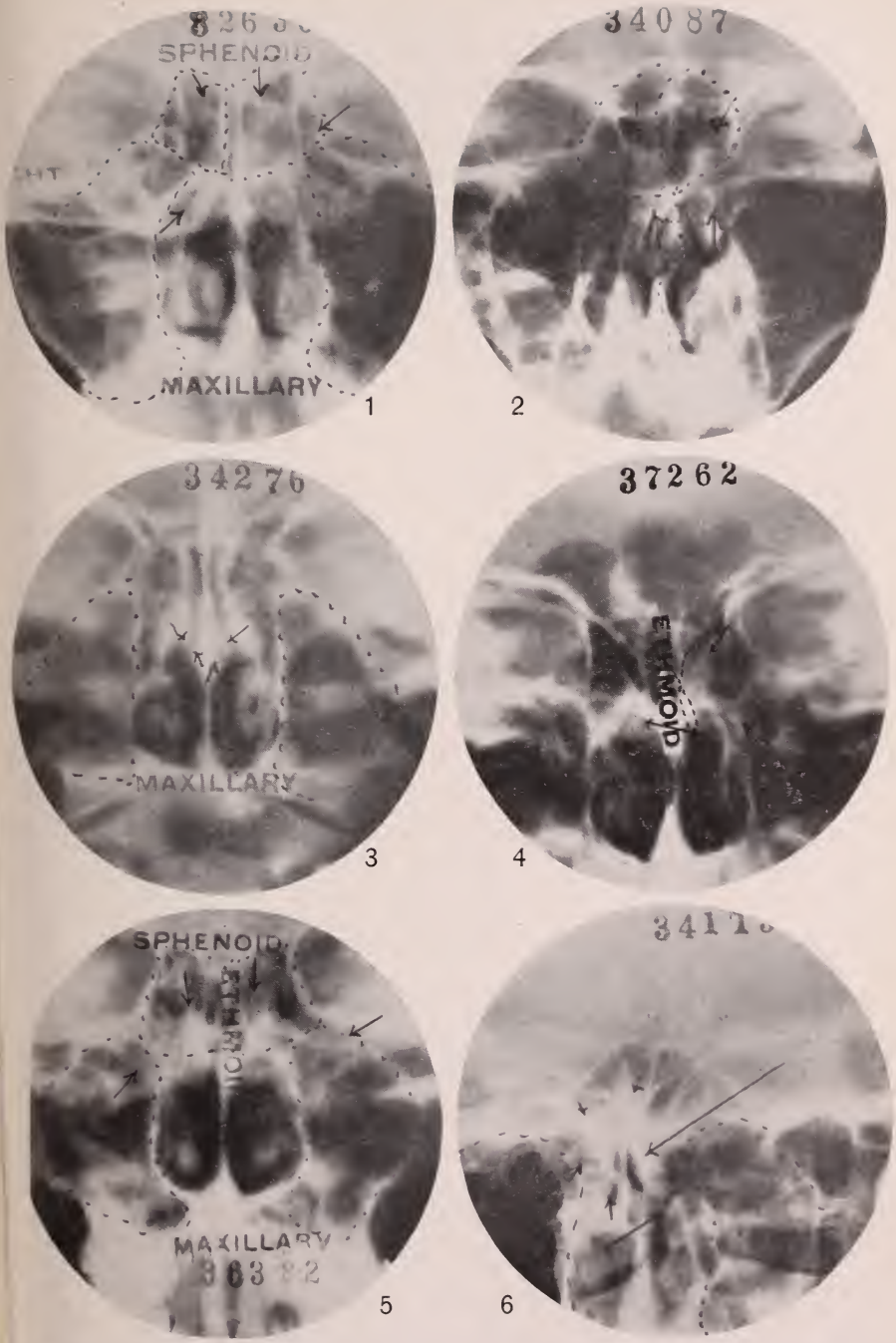
The results ranged from no relief whatever, and possibly in two or three cases evident detriment, to complete relief of discomfort, an apparent increase in patency of tube, improved hearing and relief of tinnitus. We shall refrain from presenting series of these cases, about 50 in number, because subsequent case records are incomplete, time periods are at variance and measures of improvement are not accurate.

Citing a favorable case in each group: First, Mr. R. T. H., professor in a near-by woman's college. Treatment of local and general reconstructive type for one and one-half years, totally ineffective; submucous operation on the septum entirely relieved stuffiness and tinnitus, continued comfort reported for three years, until the patient accepted a position in California. Second,

Miss L. B. S. Consultation about twelve years ago for general rhinopharyngeal involvement, rapidly increasing deafness, tinnitus, patient psychically, at least, becoming unfitted for vocal supervisor's work in a high-school system. Three operative procedures were done in two stages, external correction for a marked deformity, separating nasal processes of superior maxilla, later submucus for a high posterior deflection and with intervening vertical strip of cartilage undisturbed, correction for displaced columnar cartilage. After twelve years the patient semi-occasionally visits the office for intratubal treatment, but hearing improved and effective in musical work. Third, Rev. Dr. F., aged sixty years, about to relinquish preaching because of a complete deafness in one ear, marked roaring tinnitus, badly stuffed nose with vertical deflection of the septum. Treatment somewhat effective but inadequate, operated on June, 1923, submucous and a portion of the ethmoid on the opposite side. Returned in December; remarkable change—tinnitus practically gone, hearing tests in more favorable ear had increased 100 per cent and in the deaf ear had come up to a definite appreciation of sound in all three fork ranges. He complained of some vertigo which sent him to the office. An internist convinced him that this trouble was due to overeating. These are, of course, the good cases; many show little or no help, but is not the effort justifiable, and may it not retard backward progress?

II. For the purpose of this paper, an attempt was made to study a group of cases representing, on inspection examination, reasons for suspecting insidious changes influenced by the septum-ethmoid relation. For this study, cases must represent a controlled group, whose responses would be accurate and who could be estimated under an equal condition. They must represent essentially non- or semipathologic conditions, at least those whose ear changes are not far abnormal. The records and statistics of office practice would scarcely suffice, as this represents a balance of well-advanced pathology, and we are studying only incipient underlying factors.

The array of school examination material is only indicative,



FIGS. 1 to 6.—*X*-ray of accessory sinuses taken by Dr. Pfahler, illustrating the septum-ethmoidal complex.

can scarcely be controlled for scientific investigation and hearing tests are wholly unreliable. Again, our dispensary patients cannot be depended upon for uniform examination, as they would not voluntarily assist, and, furthermore, represent advanced pathology. Perhaps the most available material would be represented in the army, large business organizations, plants with official medical direction and the higher educational institutions, with patients of controllable age and adequate medical supervision. Of these available groups the collegiate has the advantage of regularly published reports of infirmary service, with a background of repeated physical examination and constant routine observation. One is also impressed with the apparent fact that from 60 to 75 per cent of the routine medical treatment here is for involvement of the upper respiratory tract, so this affords an opportunity of unique correlation in this field. For the purpose of this topic, an effort was made to make a parallel investigation of a small series of these cases, recorded as presenting a marked septal error. From a group of 85 so recorded an initial series of 30 was selected, and with the able coöperation of scientific assistants of ability, who aided in device of apparatus, the recorded series of tests were taken. The subjects were not recorded as deaf except in 3 unilateral cases accidentally included. All represented a possible septum-ethmoid complex, and while the list is too small to represent any real proof and the results may mean nothing, they are at least suggestive and indicate an effort to approach this from an unusual angle. The procedure follows: First, the writer examined each case intranasally and rated the picture arbitrarily from the 1st to the 5th degree in variation of ethmoid pinch. Second, functional tuning-fork tests, A : 50, A : 200, and C : 2000, with Rinné and Weber variations were taken. This, of course, was nearly uniformly normal, but even slight variation was similarly rated in the 5 degrees. Third, the watch test for distance was next taken, as distance available did not favor voice and whisper test, and these were similarly rated for each ear. Fourth, by a simple type of electric transmission with telephonic ear receivers, the fine perception difference of the two ears was recorded on a

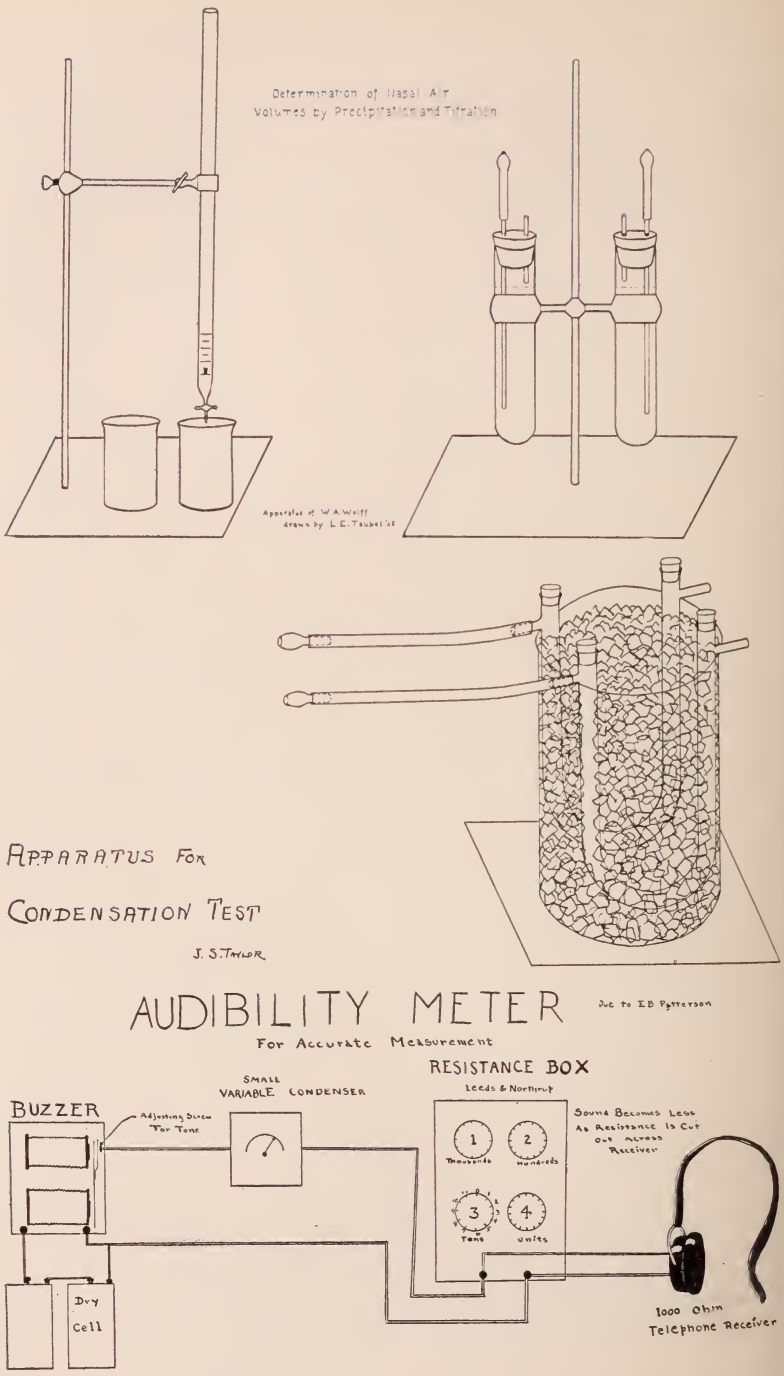


FIG. 7.—Apparatus for determining bilateral nasal respiratory coefficient.

500-vibration tone. This was simply to detect any difference between the two ears, and was so slight as to mean nothing in most cases; nevertheless, they were rated for comparison.

Fifth and sixth, two methods were devised to measure the relative air currents in the two sides of the nose, one based upon aqueous vapor condensation and weight of water obtained and the other depending upon carbon-dioxide reduction and titration with barium hydroxide—both to determine the relative amounts of air exhaled from the two sides. As a matter of interest, and because it was possible, leukocyte differential was taken by Dr. Taylor in each case, but this has no significance in the comparison. These devices, with their originators, are represented on the charts shown, but in the present form are too tedious for routine service, nor is it conclusive that either intranasal picture or bilateral movement of air have any valuable interpretation. They have, however, the simple advantage of being rated absolutely independently, both as regards test-rating and subject. So the curves plotted and shown in charts, inaccurate as they may be in abscissa unit, are unbiased, and are at least interesting and might stimulate more conclusive tests.

The deductions are certaily unique: First, the composite evidence indicates considerable conformity in lateralization of functional, Weber and audiometric tests, at least a 75 per cent conformity; second, the condensation and carbon-dioxide tests coincide in a considerable majority of instances; third, and this is striking, the rating of observed intranasal picture does not coincide in any degree with the actual air movements recorded by the other tests. The writer's estimate may have been at fault, or too hasty judgment made of various anatomic intranasal features, or, on the other hand, as suggested by McHenry, the lateralization of hearing, intranasal picture and capacity for moving air may mean nothing. This however, will be disputed in the results of operative interference suggested by the *x*-ray plates to be demonstrated by Dr. Pfahler, and accompanying this paper.

We do venture this assertion, however: It would be entirely possible to devise simple means for registering the bilateral nasal

caliber in thousands of cases, for correlating this with tubal indications in as many and justifying greater or less attention to familiar processes, when such would be of value, in incipient conditions. According to Fraser, "We know how often inflammatory affections

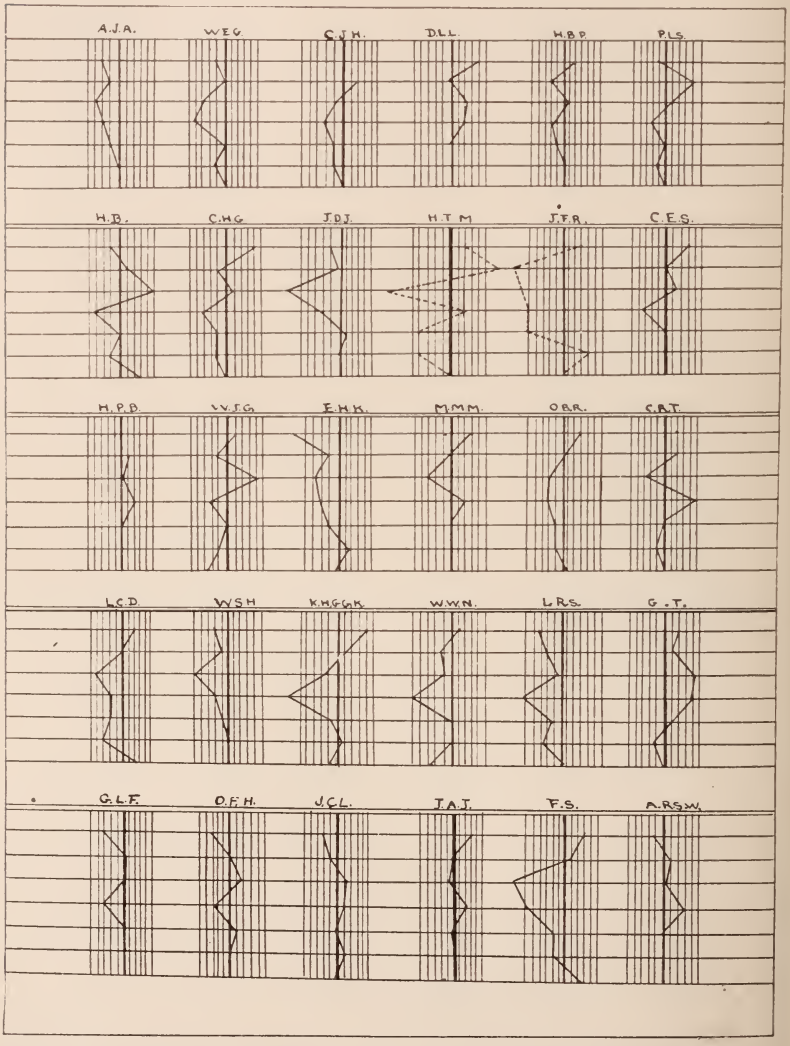


FIG. 8.—Chart curves of ear tests in septum-ethmoid complex with nasal respiratory lateralization.

of the head lead to bone disease of the turbinals, cases of nasal polyps and ethmoiditis," and, according to Bordley, "That lymphoid tissue is a normal constituent of the tube and that its cells infiltrate the tunica propria of loose connective tissue below the mucous membrane, thus giving rise to true adenoid structure;" . . . "It seems, undoubtedly, to react to such stimulation as catarrhal and infectious processes in the nose and throat, etc."

The reproductions of the *x*-ray examinations accompanying this paper as made by Dr. Pfahler are self-explanatory. The exudative pictures in the series are taken from routine cases whose very evident septum-ethmoid relation warranted radiographic examination, and will, in a measure, justify the purpose of this paper and stimulate discussion.

The chronic deaf deserve the expenditure of real research effort, toward the relief of blocked Eustachian tubes and the possible relief of subjective noise. Their famished response to possible *x*-ray and osteopathic relief deserves our attention and the sociologic syndrome is too important to be overlooked.

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MAY 21, 1924

Studies of Streptococcus Hemolyticus in Tonsillar Crypts

BY CURTIS C. EVES, M.D., AND W. R. WATSON, M.D.

It is not with the idea of presenting anything new and startling that we have chosen this subject for discussion. To the contrary, the vast number of articles already published regarding the char-

acteristics of the hemolytic streptococcus would almost seem to have exhausted every possibility of anything new in this theme. It may be said, therefore, that this paper is presented more or less in an interrogatory sense, in that we ourselves are at a loss to nominate any specific place in the cosmos for this microörganism, but hoping nevertheless to so agitate further research along this line that certain questions may finally be answered. Curious to relate, considering the magnitude of a subject so thoroughly studied withing the last ten years, there still seems to be, justly or unjustly, a streptococciphobia, if we may be permitted to coin a word, in the minds of most medical men for the hemolytic streptococcus. In fact, notwithstanding its presence in the tonsil has not proven a detriment to the patient in a great majority of cases, it is surprising to find how easy it is to convince the average physician that its mere incidence in this organ condemns the latter to immediate eradication.

Our attention was especially attracted to this subject during the examination of something over 450 children attending certain private schools in the suburbs of Philadelphia in the falls of 1922 and 1923. Besides an examination of the ear, nose and throat, a culture was taken from the tonsils of every child who still possessed them. These children, of an age ranging from eleven to twenty years, were individuals living in what might be termed the higher strata of social life and among the most approved hygienic surroundings. We make this statement with the view of directing attention to a curious phenomenon which occurs in further and later studies of cases obtained from a neighborhood where the question of hygiene is, to say the least, primitive, the findings of which we have tabulated below, together with the results of cultures obtained from the school children and 100 cases from our private practice, as well as a series furnished by Dr. Russell Richardson.

In the group of cases we have referred to as living in poor hygienic surroundings we were careful to select only such tonsils as appeared to be perfectly healthy from which to take our cultures, and, moreover, it may be stated that the throats of the school children

already spoken of were in the majority of cases also lacking in acute pathology. Our idea in doing this was to prove beyond all doubt in our own minds that the normal tonsil actually harbored the Streptococcus hemolyticus as a rule. But in the series of cases we report as furnished by Dr. Richardson, as well as in the 100 we cultured in our offices, the tonsils were palpably diseased. Our findings, as tabulated, are as follows:

Cultures taken from 170 students in "H" school, fall of 1922: 58 per cent were carriers of hemolytic streptococcus. Of this series,

17, or 10 per cent, were carriers of an almost pure culture.

44, or 25 per cent, were carriers of a flora in which the hemolytic streptococcus predominated.

29, or 17 per cent, were carriers of an equal number of colonies as of other microörganisms.

9, or 5 per cent, were carriers of hemolytic streptococcus, but in which other organisms predominated.

Cultures taken from 100 students in "H" school, fall of 1923: 75 per cent were carriers of hemolytic streptococcus. Of this series,

31, or 31 per cent, were carriers of an almost pure culture.

18, or 18 per cent, were carriers of a flora in which the hemolytic streptococcus predominated.

17, or 17 per cent, were carriers of an equal number of colonies as of other microörganisms.

9, or 9 per cent, were carriers of hemolytic streptococcus, but in which other organisms predominated.

Cultures taken from 62 students in "G" school, fall of 1923: 84 per cent were carriers of hemolytic streptococcus. Of this series,

17, or 27 per cent, were carriers of an almost pure culture.

19, or 30 per cent, were carriers of a flora in which the hemolytic streptococcus predominated.

9, or 14 per cent, were carriers of an equal number of colonies as of other microörganisms.

7, or 11 per cent, were carriers of hemolytic, streptococcus but in which other organisms predominated.

Cultures taken from 100 patients in private practice referred for examination of tonsils to determine as to whether they might be the seat of focal infection. Of this number 70 per cent were carriers of hemolytic streptococcus to the following extent:

46 per cent contained large amounts of the pure culture of hemolytic streptococcus.

20 per cent in moderate amounts with other organisms.

20 per cent carried large amounts of Streptococcus viridans. Only 10 per cent failed to carry either.

Careful cultures taken from the deep crypts of 75 dispensary adult patients since the fall of 1924 showing no pathology of the tonsils, with the following result:

13 patients, or 17 per cent, carried hemolytic streptococcus in large amounts.

3 patients, or 4 per cent, carried hemolytic streptococcus in small amounts.

11 patients, or 14 per cent, carried Streptococcus viridans in moderate amounts.

Series of cases furnished by Dr. Richardson in which the tonsils were cultured, together with a control culture taken from the mouth. Of this series there were 212 throats cultured, of which 39 were negative, 51 were doubtful, and 122, or 57 per cent, were positive.

Thus, it may be seen, so far as our own researches are concerned, that the natural habitat of the Streptococcus hemolyticus is the crypt of the tonsil. We are more than supported in this contention by other observers, who go so far as to say that the further one gets away from the crypt the scarcer this organism becomes. For instance, I. Pilot and D. J. Davis (*Journal of Infectious Diseases*, April, 1919), state that: "It is worthy of note that hemolytic streptococci were found on tonsillar surfaces in a decidedly higher percentage (61 per cent) than in the pharynx (43 per cent). Of interest, too, is the occurrence of hemolytic streptococcus in the crypts in 97 per cent, as compared with 61 per cent on the tonsillar surface." Parenthetically it may be stated that Nakamiera (*Annals of Surgery*, January, 1924), concludes that streptococci

occur more commonly and in larger numbers than other bacteria in the parenchyma of extirpated tonsils. He states also that the incidence and relative numbers of hemolytic streptococci increase with the coming of cold weather and the prevalence of tonsillitis and allied conditions.

Therefore, speaking from the view-point of the pharyngologist, the fact being fairly well established that the home of the hemolytic streptococcus is in the crypt of the tonsil, we have asked ourselves the following questions:

1. What is the significance of the incidence of this organism in the tonsil crypt?

2. What rôle does it play, if any, in either the prevention or cause of disease?

3. Is it, *per se*, of such a sinister character as it is pictured, or, in other words, has the medical profession properly gauged the potentiality of this organ for its supposedly excessive ill-effects in certain conditions?

With reference to the first question, we must frankly confess our ignorance on the subject. Hypothetically, we assume that the organism is found in purer culture and more often in the crypt because of its isolated position, away from such influences as would tend to weaken its growth, but what its significance is, is still a mooted question, so far as we are concerned. It may, indeed, have no significance whatsoever, other than that certain organisms are found everywhere. And this fact we would accept without the trouble of any further research in the matter if it were not that the hemolytic streptococcus was so consistently the predominating organism in the majority of cases we have had under observation. Since this is so, and in quite a number an almost pure culture was returned, we have formed the opinion that its presence in the crypt is not purely coincidental. As a tentative explanation we can easily conceive of a theory in which the Streptococcus hemolyticus was in its inception an ordinary streptococcus of no particular family, which, in the adaptation of itself to an environment of germicidal influences, such as acids and alkalis of the mouth, as well as tooth washes, gargling fluids, etc., sought

a home less dangerous to itself, and in the evolution of its life cycle acquired a proteolytic character by which it was able to liquify the plug of mucus covering the mouths of the crypts, and thus eventually arrived at its final haven in the extremity thereof. And we know, of course, that through evolution certain organisms common enough in the beginning may finally become specialized and take on an importance out of all proportion to their original form.

As to its rôle in the cause and prevention of disease, we seem to have fairly good evidence in the belief that the beta-hemolytic streptococcus plays a very beneficent part in the prevention of acute tonsillitis. Quoting from an article by Felty and Bloomfield (*Johns Hopkins Hospital Bulletin*, November, 1923), they state that: "In a previous paper it was pointed out that people who were tonsil carriers of beta-hemolytic streptococcus failed almost uniformly to develop tonsillitis, whereas the incidence of the disease in those who were not carriers was over 40 per cent." In another paper published in the same bulletin they also state that: "It has been possible very definitely to define susceptibility to tonsillitis. Carriers of beta-hemolytic streptococcus are practically immune. Non-carriers are highly susceptible."

We have been unable to find any confirmation of these rather radical statements by Felty and Bloomfield in the literature, but since they seem to have taken great care in working out their conclusions we are not inclined to challenge what they publish as facts, especially since our experience along laboratory lines is so limited. But in order to corroborate in part the truth of their statements we have certainly noted so frequently in our own work in the hospitals and in our offices that certain tonsils which would impress one as being on the point of blooming into frank inflammation, seldom do so, and on inquiry the patients invariably deny ever having had tonsillitis, notwithstanding their tonsils possessed all the classical appearances of being sites of a focal infection. We have no doubt, therefore, that these latter forms of tonsils were strongly fortified by the presence of the beta type of hemolytic streptococcus.

This immunity for tonsillitis, in our opinion, is not through any inherent virtue donated by the beta-hemolytic streptococcus itself, but an acquired immunity through the tonsil receiving doses of the emanation of an especially virulent type of the organism over long periods of time. This would make it appear that in our estimation the beta type of hemolytic streptococcus is not so benign as it would seem to be. We mean, of course, that in association with other more virulent microörganisms which may invade the sytem in sufficient numbers it is capable of turning against its host to become a very real menace and potent auxiliary in certain complications. We can best explain what we mean by citing from an article published by J. Martin Beattie in the *British Medical Journal*, November 12, 1921, as follows:

"It is significant that in the various infections a common starting point is the throat. One of the earliest symptoms is 'sore throat,' and in such cases the hemolytic streptococcus can generally be demonstrated in large numbers, and this same organism is found later in the complicating lesions. Taking an average of several observers in four common diseases, the prevalence of these hemolytic streptococci is striking:

	Cases.	Per cent.
"Scarlet fever	131	91
Measles	538	72
Influenza	340	70
Lobar pneumonia	151	50"

And again, he states that: "Pilot and others in 1918, during the pandemic of influenza, isolated hemolytic streptococcus from the lungs in 43 per cent of the cases. Cole and MacCallum states that the hemolytic streptococcus is the chief if not the only cause of bronchopneumonia following measles."

The general consensus of opinion seems to be, therefore, that the Streptococcus hemolyticus, especially the beta type, when alone and confined to the tonsillar tissue is of a benign and charitable character. In the presence of other pathogenic microörganisms, however, it becomes the chief offender in many complications.

This partially but not completely answers our third and last question. If one were to ask indiscriminately all medical men that he met: "What do you think of the streptococcus hemolyticus?" almost invariably one would get a somber shake of the head and the reply: "Very bad—very bad!" or, as one of our colleagues answered us: "When he is good he is very, very good; but when he is bad he is horrid." Which reply, when it is analyzed, although somewhat frivolous, seems to approach the truth as nearly as one can get to it in the present light of our knowledge of the hemolytic streptococcus.

Incidentally, we wish to invite attention again to the discrepancy in the laboratory returns from the series of cases obtained from the Pennsylvania Hospital dispensary as compared with the cases from the private schools mentioned. As we have already intimated, the individuals composing these separate groups are living under entirely different hygienic conditions: Those coming from the dispensary, as you already know, being members of the great unwashed proletariat, and the school children living in almost ideal surroundings.

Why this discrepancy exists we are not prepared to say. It would seem that where a collection of individuals are grouped together, such as school children, interns, nurses, etc., the percentage of carriers of the hemolytic streptococcus is more consistently found as compared with cultures taken from a scattered community irrespective of their hygienic condition.

In summing up the evidence for or against the Streptococcus hemolyticus, therefore, we regret that we have nothing new to offer except substantiation of a fact that has already been amply proven: That the home of this organism is in the crypt of the tonsil; that it has benign influence on the tonsil itself; that, theoretically, it may, in certain specialized physical conditions, be the etiological factor in some of the infectious diseases; and lastly, that it has been pretty well proven to be associated in many of the complications of all infectious diseases.

A word in conclusion to record a few other facts which came under our observation during the study of the cases as above cited:

In none of these series did we find any macroscopical evidence which would enable us to determine the presence or absence of any one class of organism. Deeply congested bands along the margins of the anterior pillar and pharyngeal wall, as well as congested tonsillar tissue, may be found from infection of any of the more virulent organisms. Neither has it been possible to determine the character of the infecting organism by the amount, consistency or color of the secretion expressed from the crypts. Until more definite evidences are produced by the laboratory one must determine the advisability of removing diseased tonsils upon the history of the patient, the appearance of the tonsil and surrounding tissue, the amount and character of the secretions expressed from the tonsil, and the condition of the cervical glands. In doubtful cases a culture taken from the deep crypts showing a predominance of any form of streptococcus, should influence one to advise removal.

Case Reports

Dr. George B. Wood reported a case of pulmonary abscess with complete recovery following tonsillectomy. Detailed history of the case was given. After one month's bronchoscopic treatment the patient was discharged cured. Lantern slides demonstrated the progress of the case after bronchoscopy was instituted.

Dr. William E. Quicksall presented a paper: "Bilateral Mastoid Operation: Complications; Treatment with Mercurochrome."

J. M. S., male, aged two years, admitted to the medical service of St. Joseph's Hospital, March 31, 1924, with high fever, cough, vomiting and twitching of the limbs. Family history negative; both parents robust and well. Has been in very good health until two months prior to admission, when he had discharge from both ears. The right ceased in a few days, the left one continuing to discharge at intervals ever since. About one month ago he had fever and vomiting of short duration, attributed to a gastric disturbance, with no return until the day before admission.

Physical Examination. Enlarged, slightly infected tonsils; left cervical adenitis; slight mucoid discharge from left ear; a few scattered rales over both lungs; slight twitching of the limbs.

The medical service finding nothing to adequately account for the severity of the symptoms, an ear, nose and throat examination was made, April 2: Right tympanic membrane was intact, slightly injected, with no bulging. Left membrane almost normal in color and contour; slight mucoid discharge. No mastoid tenderness on either side. Report made that the involvement of the ears seemed too slight to account for his symptoms. Neurological examination, April 3 was negative.

April 4: Leukocytosis, 15,200. Temperature, 107° per rectum. Both membranes incised, with no improvement. Retraction of the head noted. Our neurologist said he believed a basilar meningitis was developing.

Operation, April 5: Pus found in left mastoid antrum. Unusual development of mastoid, with large cells filled with old granulations. Healthy bone was reached and no examination made of lateral sinus or dura.

April 9: Increased signs of meningeal irritation. Right mastoid opened and small quantity of mucopus and old granulations found.

Temperature continued markedly septic in type, with a range of 8°. The highest was 106$\frac{1}{5}$° by axilla, when the child appeared critically ill, When the temperature dropped to normal or below, he was bright and seemed almost well.

April 12: Blood culture positive for pneumococci and staphylococci.

April 13: Eye-grounds negative. No choked disk.

April 17: Lumbar puncture negative, except for slightly increased pressure.

April 23: Mecurochrome intravenously, 40 mg. Five milligrams to the cubic centimeter. One cubic centimeter to each kilo of body weight. There was no untoward reaction, only slight lessening of the urine at first.

The urine having become nearly clear, a second similar injection was given four days later, with no serious after-effects.

Since that time the child has steadily improved, the temperature not having risen above 101°. It has been practically normal for two weeks; what slight elevations there have been, can be accounted for by a recurrence of the cervical adenitis.

Dr. F. O. Lewis presented 2 cases of cancer involving the maxillary antrum. In 1 case maxillary sinus alone was involved. Treated with radium and *x*-ray; no improvement. Removed upper jaw and used electric coagulation and then radium. This man is now doing work and is fairly comfortable. Dr. Lewis advised getting cases early and then they would be favorable. Most cases are obtained too late.

Dr. Ralph Butler presented 3 cases—2 of nasal carcinoma and 1 of pharyngeal sarcoma. Two are now in good condition, were given relief, but not cured. The subsequent history of the third is not known. Radium was used in all cases.

Dr. R. H. Skillern discussed the "Ethmoidal Problem." The speaker cited types of old, chronic, purulent ethmoiditis, and said we were at a loss to know what to do with these cases. The other sinus infections were ruled out easily and ethmoid involvement was left in conclusion. He presented 2 cases, 1 with no operation done and the second with frequent operation, and discussed in the conclusion as to which was the better result. One must approach these cases with timidity, as often an operated ethmoid is a "patient for life." Dr. Skillern showed that in these 2 cases presented there was no atrophic rhinitis and very little difference objectively in the result. In conclusion, he advised going slowly in these cases, and if operation is performed to leave the ethmoidal labyrinth undisturbed. He outlined also the cotton tamponage treatment with silvol.

OCTOBER 15, 1924

Mastoidectomy on a Case of Mastoiditis Streptococcus Hemolyticus followed by Septic Phlebitis: Recovery without Operation upon the Sinus

BY E. B. GLEASON, M.D.,

AND

PHILIP S. STOUT, M.D.

(by invitation.)

Dr. Gleason presented a child, aged six years, upon whom Dr. Stout had done a radical mastoid operation in May, 1924. The history of the condition and development previous to operation was not unusual and showed no departure from the usual clinical course of such conditions. At operation the left mastoid was found to be filled with pus and the bone showed osteomyelitic changes. Thorough drainage was accomplished without exposure of either the lateral sinus or middle fossa.

Several days following operation the child's temperature began to show wide excursions, reaching at times 105° F., and being septic in type. A blood culture at this time was positive for Streptococcus hemolyticus, which was the organism present in the mastoid pus. The mentality was well preserved. Leukocytes, which were at first 11,800, rose in a week to 28,300. Dr. Gleason considered the case one of infective thrombosis of the jugular bulb. Several other observers disagreed with this diagnosis. It was decided to withhold operation. A stormy convalescence, complicated by acute endocarditis and a metastatic abscess of the right hip requiring drainage, and the contraction of measles, ended in recovery, and discharge of the patient on August 8, 1924.

It was the feeling of Dr. Gleason that few mastoid cases require early operation, *i. e.*, before a week or ten days. This allows time for a walling off of the process and ensures a much shorter convalescence. In early operation a tedious recovery is more frequent

and many more cases so treated require secondary operative procedures. The most interesting feature of this case as presented by Dr. Gleason was that spontaneous recovery occurred without operation, where the symptoms gave a rather definite clinical picture of sinus thrombosis.

Dr. P. S. Stout felt that in this case prompt operative measures were largely responsible for recovery.

Dr. Stauffer questioned the surety of the diagnosis of jugular sinus thrombosis. He cited a similar case where a secondary collection had appeared in the opposite mastoid.

Dr. Wood considered the steeple type of temperature and other symptoms of this case sufficient to warrant the diagnosis of sinus thrombosis, but felt that with children great care must be used in making such a diagnosis, especially as they are so susceptible to wide temperature variations from many causes. He invited discussion of the diagnosis of sinus thrombosis.

Dr. Eves considered the diagnosis of this case pretty definitely sinus thrombosis, when the positive blood culture, previous history, temperature curve and other symptoms were considered. The case in his mind was one for operation. He cited several similar cases. One operated upon recovered, following the removal of a sinus clot. Another upon whom operation was delayed died. Only if a patient has marked resistance can one afford to delay operation in mastoid cases.

Dr. Cariss raised the question as to the time of development of the acute endocardial condition.

Dr. Coates did not feel that the type of organism played much part in the tendency to the development of sinus thrombosis. He cited several series of cases which tended to show that sinus thrombosis was more likely in pneumococcic mastoiditis than when the hemolytic streptococcus was the exciting organism.

Dr. Babbitt cited cases of sinus thrombosis: In one—a hemolytic streptococcus infection—blood transfusion was of great value; in another 1 per cent mercurochrome intravenously produced a prompt return to normal temperature.

Dr. S. MacCuen Smith considered the symptoms of this case indicative of a definite diagnosis of sinus thrombosis. In his opinion, in this condition, the temperature may be constantly elevated or show the steeple phenomenon. A differential count is of some value. A retained clearness of mentality is usually present in this condition and should be considered. If possible it is advisable to await a walling off of the infective process. The blood culture is not always positive. He cited several cases of supposed thrombosis where mercurochrome was used, all of which recovered. When operation is done he feels that many cases will recover without ligation of the jugular vein. In fact, the additional shock of this ligation often offsets any advantage it may give. In the average case, if at operation free bleeding can be obtained from both ends of the sinus after removal of the clot, it is best not to ligate. As a general rule he feels it is probably the safest procedure to ligate. Many cases recover with no venous ligation.

Dr. Lewis called attention to a case of double acute mastoiditis upon which bilateral mastoidectomy was performed. A subsequent lateral sinus thrombosis developed. Some difficulty was experienced in determining which side was affected. Eventually this was done and operation performed with uncomplicated recovery.

Dr. Randall called attention to a differentiation between sinus phlebitis and thrombosis. To definitely differentiate is practically impossible, as the former precedes the latter condition. If the process goes no further than phlebitis the patient has the better chance if not operated upon. In acute cases, in children especially, nature's tendency is to close the sinus without the formation of a septic thrombosis. It is in the long-standing, more chronic cases where clotting is likely to occur. In cases such as these operation gives the best results. In very acute cases, however, it is best to delay operation. A positive blood culture is greater evidence of phlebitis than of a thrombosis. One should not forget that metastatic abscesses elsewhere can well account for symptoms of sinus thrombosis.

Dr. Walter Roberts stated that when sinus pus is definitely walled off ligation should not be done.

Dr. George Fetterolf cited a case which showed remarkable resistance to hemolytic streptococcic infection. The mastoid, lateral sinus, jugular vein, sternoclavicular joint, knee-joint, appendix and pleural cavity were successively involved and all surgically treated. All lesions showed the hemolytic streptococcus. Recovery followed. One must therefore not fail to consider individual resistance in all cases of infection.

Dr. E. B. Gleason stated that his diagnosis of the infective process being lodged in the jugular bulb rather than the lateral sinus was based upon observation that during operation the lateral sinus had not been exposed and that in the wound healthy granulations were present over this area. Then, too, in the child, due to anatomical conditions, the jugular bulb is more readily infected than in the adult. In operation for sinus thrombosis Dr. Gleason has never tied off a jugular vein. Sometimes he has at operation found no clot, which, he felt, substantitated the statements of Dr. Randall concerning phlebitis. If a week or more has elapsed in these intracranial cases it is the feeling of Dr. Gleason that they will spontaneously recover.

Dr. Stout stated that the presence of an endocardial infection was present postoperatively only. It is his feeling that the streptococcus and pneumococcus frequently occur together, one in the pus, the other in the spinal fluid.

Report of a Case of Sarcoma of the Nasopharynx

BY WALTER ROBERTS, M.D.,

AND

GEORGE SCHWARTZ, M.D.

(by invitation.)

Drs. Roberts and Schwartz reported the case of a woman, fifty years of age, who came to them complaining of stuffiness of the right

ear accompanied occasionally by paroxysmal pain. At first these symptoms were relieved by inflation. Later this maneuver gave no relief. Digital examination of the nasopharynx revealed a dense mass as large as a walnut attached to the left wall. Palpable cervical glands on the right side were discovered. Laboratory and other examinations revealed no evidence of constitutional disease such as syphilis or tuberculosis. A radiologist who was consulted advised operation, as he was unable to reach the mass for radium applications. The growth was removed by section of the superior maxilla and soft palate. The pathological report was round-cell sarcoma. To date there has been no evidence of recurrence. The residual slit in the soft palate makes the locus of the original growth quite accessible for any sort of treatment. With the plate of her false teeth and nasal obturator the patient is quite comfortable.

Dr. Lewis stated that one of the most difficult problems of the rhinologist is the nasopharyngeal neoplasm. Pain in the ear is a frequent initial symptom. Before suspecting any growth the tumor may attain quite large dimensions. He cited the case of a boy, sixteen years of age, from whom he removed a round-cell sarcoma from the nasopharnx by means of the snare and forceps. After six weeks there has been no sign of recurrence. At the Philadelphia Hospital he stated that radium application to the site of growth had given the best results.

Dr. Pfahler remarked that he considered it best to radiate and *x*-ray all these cases before operation. In the clinic of Frankford, Germany, he said, all such cases are treated solely by radiation.

Dr. Randall considered operation in this case the proper procedure, due to the fibrous nature of the growth. Radium too should be applied.

Dr. S. MacCuen Smith cited a case treated by Dr. Pfahler with *x*-ray and radium which developed marked metastasis and died. He raised the question of possibilities of surgery in this case.

Dr. Pfahler replied that this case of sarcoma was so far advanced that marked constitutional derangement had already occurred and that therapy of any sort would have been of no avail.

A contrast of surgical and radium therapy statistics would, he felt, speak favorably for radium.

Dr. Randall called attention to a case of sarcoma which had completely recovered under treatment with Coley's fluid.

Vincent's Angina: A Review of Some Recent Literature and a Report of two Cases

BY THOMAS AIKEN, M.D.

Dr. Aiken pointed out that dental caries probably predisposes to and augments Vincent's angina. He called attention to the fact that death may result from this condition. He reported the successful treatment of two cases after the manner of Barenberg and Bloomberg, as reported in the *Journal of the American Medical Association*, July 5, 1924. In brief, this treatment consists of local applications of hydrogen peroxide to the infected areas followed by a strong aqueous solution of sulpharsphenamin. Injections of the latter drug were also made in the gluteal muscle. He called attention to a case reported by Dr. David Husick which died even though the above treatment was followed.

Dr. Ersner stated that he had seen several cases die after the condition had apparently cleared up—one from pernicious anemia, another from lymphatic leukemia. He felt that the condition itself was an expression of lowered resistance. The Vincent's organism being anaërobic, hydrogen peroxide is of value as a therapeutic oxidizing agent. During the course of the infection the mouth is acid, and as the condition clears up a gradual return to alkalinity is noted.

Dr. Wood stated that as long as the disease is limited to the tonsil, pure phenol readily effects a cure.

Dr. George Fetterolf confirmed the observation of others that fruit juices in large amounts seem to be of therapeutic value.

Dr. Aiken stated that cases showing this condition do appear to have lowered resistance.

Report of a Case of Carcinoma of the Tonsil

BY N. P. STAUFFER, M.D.

Dr. Stauffer reported and demonstrated a case of carcinoma of the right tonsil in a woman, aged sixty years, with no recurrence a year after treatment. The laboratory diagnosis of the lesion was carcinoma. The treatment was carried out by Dr. Pfahler and consisted of radium applications to the primary focus and *x*-ray therapy of the cervical glands which had been markedly involved. Complete healing of the primary focus took place, as well as diminution in size of the enlarged cervical glands. Constitutionally she also improved, gaining in both weight and strength. Mention was made of another case, a male, aged sixty-four years, with a malignant growth at the base of the epiglottis. Although this case has had several radium and *x*-ray treatments by Dr. Pfahler and Dr. Newcomet the growth seems to be advancing.

Dr. Pfahler stated that the first patient mentioned was treated to the limit of tolerance for two months with radium element. The neck was treated to the limit of tolerance with *x*-ray.

Dr. Lewis asked if tonsil malignancy was not particularly favorable to radium treatment. He cited nine cases of such malignancy, treated as above, with no recurrence to date.

Dr. Pfahler replied that different carcinomas respond differently to radiation, each being a law unto itself. As a general rule malignancy of the tonsil and thyroid react more favorably to radiation than those elsewhere located.

Dr. Lewis asked Dr. Pfahler if he had seen any permanent cures effected by radiation in laryngeal carcinoma.

Dr. Pfahler replied that in this location adequate radiation was difficult, due to the tendency to laryngeal edema. He had seen no cures lasting more than three years. In such cases he thought operation advisable.

NOVEMBER 19, 1924

The Diagnosis of Laryngeal Diseases

BY CHEVALIER JACKSON, M.D.

Dr. Jackson first presented the laryngostat, an instrument which allows a direct view of the larynx without penetration between the vocal cords. Later several specimens removed from various animals were demonstrated, among which were hair balls from the stomach of a ruminant and a pin in the gizzard of a chicken, demonstrating slow perforation by ulceration.

He next called attention to the complexity of laryngeal disease and the care essential in arriving at a correct diagnosis. Mere inspection does not suffice. Only by the most close and careful coöperation of the internist, pathologist, roentgenologist, serologist and bronchoscopist can the necessary studies be made and the proper conclusions drawn.

Dr. E. J. G. Beardsley commented upon the thoroughness with which the work of Dr. Jackson is conducted. Many cases, apparently most puzzling, after definite and thorough routine study, have proved to be quite simple. Always in laryngeal disease should all the circumstances which may have bearing upon its etiology be given careful consideration.

Dr. B. L. Crawford stated that the technic employed in the microscopic study of laryngeal tissue consists of paraffin embedding by a twelve-hour method, followed by the cutting of serial sections. Frozen sections are not of value on account of the small amount of material available. Occasionally it is necessary to perform a second biopsy if sufficient tissue was not obtained the first time.

Pulmonary Abscesses following Tonsillectomy

BY R. M. LUKENS, M.D.

Dr. Lukens stated that at the Jefferson Hospital post-tonsillectomy abscess constituted 36 per cent of the cases of lung suppuration which were treated bronchoscopically, exclusive of those caused by foreign bodies and certain forms of asthma. He stated that the incidence of lung abscess of one out of every 2500 to 3000 tonsillectomies, as stated by Moore, was probably too low.

In the series of 18 cases presented, the average period between tonsillectomy and the initial symptoms was seven to nine days. They may appear as early as one day or as late as a month following operation. Any postoperative symptoms such as fever and cough, with or without expectoration, should be eyed with suspicion, watched carefully and thoroughly investigated by means of *x*-ray and physical examination. Sometimes only the bronchoscope can differentiate between "drowned lung" and "lung abscess."

As soon as the abscess is definitely localized bronchoscopic treatment should be instituted. If an adjacent pneumonic involvement has taken place, this procedure should be withheld until its subsidence. Frequent physical and *x*-ray examinations should be made during the course of treatment. If no improvement follows six treatments, other forms of treatment should be followed. Improvement is noted by lessened cough and expectoration, disappearance of the odor, clearing of physical signs and improvement of the *x*-ray picture. When this occurs continue the treatments regardless of the number required.

In these treatments general anesthesia should not be used. At first, hypodermic injections of morphin, and cocain locally, are necessary; as a rule these can soon be omitted. Upon the first examination the location of the abscess is determined and pus is secured for study and an autogenous vaccine prepared. Subse-

quent treatments are chiefly for the purpose of securing drainage. In early cases inflammatory swelling of the draining bronchus is the usual obstruction to drainage. Such cases are aspirated and the mucosa treated with a weak astringent solution. In older cases where granulations block the passage, gentle swabbing, or crushing by forceps, along with aspiration, is usually necessary. Weekly treatments are then given. Each time as much pus as can be aspirated is removed, the area thoroughly cleansed and antiseptic oil applied. The usual duration of such treatment is five to six minutes.

The time required to establish a cure, within limits, varies directly as the age of the abscess. In a series of 18 cases so treated, 8 cases have been clinically cured, 8 clinically improved and 2 referred to the surgeon unimproved.

Dr. Lukens drew the following conclusions:

1. Bronchoscopy is indicated in all cases of pulmonary abscess as a diagnostic measure.

2. Pulmonary abscesses should be drained by the bronchoscope at the earliest possible time after localization of the lesion.

3. Bronchoscopy, in trained hands, is a safe procedure in all properly selected cases of pulmonary abscess following tonsillectomy.

Tracheobronchial Asthma: Observations on Bronchoscopic Studies

BY WILLIAM F. MOORE, M.D.

Dr. Moore reported a series of 25 cases of bronchial asthma treated bronchoscopically. These cases, which were all subjected to protein studies, were classified in two divisions: (1) Those having an active, evident, suppurative tracheobronchitis; and (2) those having a bronchoscopically evident chronic passage conges-

tion of the trachea and bronchi. The first group of cases responds best to treatment.

Bronchoscopic treatment is based upon the idea that such treatment restores ciliary action of the epithelial cells of the air passages, which, in the kind of case mentioned, can be demonstated to be faulty. By such measures the mucous membrane is freed of material which inhibits and destroys ciliary action, the epithelial cells are stimulated to regenerate cilia and the patient's resistance is increased by the use of autogenous vaccines.

In the treatment the secretion is removed by sponging or aspiration through the bronchoscope. A solution containing 10 drops of a 10 per cent solution of cocain and 20 drops of adrenalin solution (1 to 1000) in 30 cc of normal saline is instilled after treatment. Five cubic centimeters is placed in each main stem bronchus. Autogenous vaccine therapy is inaugurated one week after the first treatment.

In cases of this sort the Streptococcus viridans, the Streptococcus hemolyticus or a hemolytic strain of the Staphylococcus aureus are almost always present in pure or associated cultures. They may be regarded as secondary invaders or causative factors.

Of the 25 asthma cases reported 7 showed no tracheobronchitis. Three of these were given temporary relief by treatment. The others were not improved. The remaining 18 cases had evident tracheobronchitis. Sixteen of these patients were markedly improved by the treatment outlined; 1 showed slight improvement and 1 no apparent change.

Ciliary Inhibition in Tracheobronchial Asthma

BY GEORGE R. MOFFITT, M.D.

Dr. Moffitt, by means of lantern slides and microscopic preparations, demonstrated the types of ciliary motion present in the epithelial cells of the lower respiratory tract. He stated that

coincident with clinical improvement following bronchoscopy the cilia of the tracheal epithelial cells became more active and numerous. He described two types of epithelial cells present in the tracheal mucosa—one of a spherical shape the other of a columnar variety—both provided with cilia and a basal elongated tapering process.

From his studies he estimated that one healthy epithelial cell possesses about 480 cilia, each of which moves 360 times per minute.

Dr. W. F. Zinn, Baltimore (by invitation): Dr. Zinn has treated a number of asthma cases by means of the bronchoscope with results that cause him to feel that the procedure is justifiable and of considerable promise. One case treated six times with the bronchoscope and application of 5 cc of 20 per cent gominal has been free from asthmatic attacks for the first time in five years. Another, an adult male, suffering from severe bronchial asthmatic attacks and who was negative to all pollen tests, after the third treatment was able to return to work and since that time has had no recurrence. He emphasized the wisdom of careful selection in cases to be so treated. If no bacterial tracheitis is present the case will probably not be benefited. In his cases Streptococcus viridans and hemolytic streptococcus were the usual organisms.

Dr. Crowell demonstrated several specimens of bronchial casts procured from cases treated in the Jackson Clinic.

Contraindications to Bronchoscopy

BY ELMER H. FUNK, M.D.

Dr. Funk stated that the number of contraindications to the above procedure varies inversely as the skill of the examiner. The following list of contraindications was given:

1. No patient not thoroughly studied should be submitted to this maneuver: This study should include careful history and physical examination, sputum, blood and urine tests, *x*-ray pictures and occasionally protein reactions.

2. Aortic aneurysm.

3. Recent massive hemorrhage (exceptions occasionally depending upon individual case).

4. Active tuberculosis.

5. Moribund patients.

6. Diffuse pulmonary suppuration such as purulent pneumonia, multiple abscesses or peripheral lung abscess.

7. Severe complications; some intercurrent serious condition such as brain abscess, typhoid fever, etc.

He gave as a general clinical rule that where needed for diagnosis or treatment, the bronchoscope should be used when no clear contraindication is present.

Foreign Bodies in the Air and Food Passages

BY LOUIS H. CLERF, M.D.

Dr. Clerf showed an interesting series of roentgenograms from a group of 75 cases in which foreign bodies of various sorts were demonstrated and removed by means of the bronchoscope. In the diagnosis of the presence of foreign body in the lungs the services of the internist and roentgenologist are indispensable. Limitation of motion and obstructive emphysema of the affected side are the most valuable aids in making a positive diagnosis where no opaque bodies are concerned.

Foreign Bodies in the Air and Food Passages

BY GABRIEL TUCKER, M.D.

The series of roentgenograms presented by Dr. Tucker demonstrated foreign bodies of all descriptions lodged in the esophagus and from which they were removed by esophagoscopy. The necessity of x-ray studies both by means of plates and the fluoroscope was stressed. He explained the mechanical emphysema occurring in the pulmonary foreign body cases in the following manner: The swelling and edema of the bronchus, due to the irritation caused by the foreign body, narrows the lumen and permits the foreign body to assume a valve-like action, allowing air to enter but preventing its escape. After a time, under such conditions, fluid secretions too are retained and the condition known as "drowned lung" with subsequent atalectasis follows. The effect of moisture and warmth upon certain forms of foreign bodies is very great. An example of the changes produced by the physical conditions is well illustrated by the bean, which swells to about $2\frac{1}{2}$ times its usual size.

The Diagnosis of Non-opaque Foreign Bodies in the Larynx and Trachea

BY WILLIS F. MANGES, M.D.

Dr. Manges showed many lantern slides illustrating roentgenograms of laryngeal and tracheal foreign bodies. A dyspneic child must always be regarded as a potential foreign body case regardless of a negative history. In non-opaque foreign body, obstructive emphysema is the most important early roentgenologic finding. Later "drowned lung" and atalectasis frequently follow, if only a portion of the lung is affected.

DECEMBER 17

Researches in the Minute Anatomy of the Internal Ear

BY GEORGE E. SHAMBAUGH, M.D.

(*Abstract*)

As emphasized by the chairman, Dr. Fetterolf, in his introduction, it is always a pleasure and an inspiration to be granted the privilege of hearing the problems, successes, failures, ultimate end-results and conclusions that go hand-in-hand with investigative work of previously unsolved or doubtful scientific questions. Such a privilege was given to the section with the appearance of Dr. Shambaugh, who spoke about his own work upon the anatomy of the inner ear.

In a vivid, forceful, yet modest manner he verbally sketched a picture of his years of careful, painstaking and time-consuming investigations of the anatomy of the temporal bone. As one listened to the speaker the truth of the axiom, "There is no royal road to learning," was driven home. In all, about eighteen years of Dr. Shambaugh's life were devoted to this problem. During this time hundreds of specimens were prepared and examined, of which many failed to conclusively demonstrate the desired anatomic points. Profiting by these failures a technic was finally obtained that beautifully demonstrated the doubtful anatomic questions.

The lantern slides showing his preparations demonstrating the circulation of the labyrinth, were of particular interest. It was pointed out that an embolus due to the peculiarities of this vasculature, could cut off the blood supply to all or selective portions of the labyrinth, depending upon the blockage of the main stem artery or one of its branches. These branches are end arteries and a blockage of one means anemic infection of the part supplied, for the collateral circulation is either slight or absent. Such anatomic

knowledge can be used in explaining many cases showing typical symptoms of Ménière's symptom-complex. It is the feeling of Dr. Shambaugh that most of the so-called Ménière's symptoms are embolic rather than hemorrhagic in origin.

That the membrana tectoria in life is attached to the hair cells of Corti's organ was clearly demonstrated by numerous photomicrographs of that part. Its separation, so often seen in preparations, is an artefact.

The striæ vascularis was shown in various stages of development, and the evidence that it is made up of both epithelial and connective-tissue structures, seems to be conclusive. It is probably along with the sulcus spiralis externus, which was demonstrated to possess a gland-like structure, concerned in the production of endolymph.

Dr. Schaeffer called attention to the fact that America has contributed much to the knowledge of the genesis, anatomy and physiology of the ear. He most strongly advocated the policy which has been followed by Dr. Shambaugh, *i. e.*, that experimental study and research should be the handmaiden of clinical medicine. He spoke of the striæ vascularis and its possible function. Is it possibly concerned in the regulation of the temperature of the endolymph? By sympathetic connection does it perhaps act as erectile tissue and by changes in its volume influence and regulate the endolymph pressure? were some of the questions asked.

Dr. Randall presented a series of lantern slides demonstrating various anatomic points of the inner ear. He defended the Helmholtz resonance theory of hearing and felt that Gray, of Glasgow, had done much to substantiate this hypothesis.

Dr. Smith stated that a knowledge of anatomy and physiology of any given part must be obtained before reasonable understanding of pathologic processes is possible. To such men as Shambaugh, Randall, Fraser, Dickie and others, who have spent much time and energy in the attempt to solve the problems of the internal ear, the profession is deeply obligated. He called attention to the mental decline of the deaf and dumb and the necessity of still

further knowledge concerning the relation of the auditory apparatus and central nervous structures. The importance of the bearing in mind by the aurist of the peculiarities of the labyrinthine circulation and its pathologic possibilities, as pointed out by Dr. Shambaugh, was emphasized.

In conclusion, Dr. Shambaugh considered the idea advanced by Dr. Schaeffer that the striæ vascularis acted as a pressure regulator, to be worthy of careful consideration. The pulse beat does cause changes in the endolymph pressure and perhaps the striæ in the same way compensates for these changes.

PROCEEDINGS

OF THE

SECTION ON GENERAL MEDICINE

JANUARY 28

Studies in Auricular Flutter, with Special Reference to Intermittent Flutter: a Hitherto Undescribed Condition

BY CHARLES C. WOLFERTH, M.D.

AND

JOHN HARVEY, JR., M.D.

Auricular flutter, like auricular fibrillation, may be conveniently classified into two groups, namely, paroxysmal and continuous. The former is characterized by its tendency to be self-limited and to recurrence. Paroxysms have been described lasting only a few minutes; more commonly they last hours or days. In continuous flutter the arhythmia tends to last indefinitely. Eventually it may terminate in auricular fibrillation, or normal rhythm may be restored.

The clinical relationship between paroxysmal and continuous flutter appears to be very close. In several cases of paroxysmal flutter, followed over long enough periods of time, continuous flutter has eventually developed. We know of no actual difference in mechanism between the two.

The cases we present might be classified as paroxysmal auricular flutter, such differences as they show from cases previously

reported being due to the remarkably transitory nature of the paroxysms. In Case I fleeting runs of flutter were found to alternate with more or less similarly brief periods of normal rhythm. In Case II the runs of flutter were somewhat less frequent. In view of the fact that the cardiac behavior in these cases is so different from that hitherto described in any case of flutter, it has seemed to us worth while to invite attention to the unusual features by designating the condition "intermittent auricular flutter."

Case I.—J. S., a white man, aged fifty years, coal miner, was admitted to the medical division, University Hospital, June 27, 1923. The chief complaints were cough and palpitation of the heart. Symptoms referable to the heart, such as shortness of breath on exertion and palpitation, were of four months' duration. The heart was slightly enlarged, but there were no evidence of valvular disease. The ventricular rate was approximately 100 and the rhythm irregularly irregular. There were no evidences of passive congestion of viscera. The tentative clinical diagnosis was chronic myocardial disease of undetermined etiology, auricular fibrillation and only moderate diminution of cardiac reserve.

Electrocardiograms showed the arrhythmia to be due to very brief runs of auricular flutter, the longest consisting of 20 auricular deflections and the shortest only 2 or 3. The paroxysms were initiated invariably by a premature beat of auricular origin, indistinguishable from an ordinary extrasystole. The auricular rhythm at the beginning of paroxysms was not quite regular. The rate tended to accelerate during the first three or four beats, then, if the runs lasted long enough, became regular at a rate of about 300 per minute. The cessation of abnormal action was usually abrupt, not being preceded by significant slowing or quickening; in the case of longer runs in which regularity had been established, there was sometimes slowing before offset.

The first abnormal auricular beat was usually followed by ventricular response, but thereafter there were usually 2, 3 or 4 auricular beats to 1 ventricular.

Paralysis of the vagus by atropin had no significant effect on incidence or duration of paroxysms of flutter. Vagus stimulation prolonged paroxysms. Small doses of quinidin were practically without effect, but 0.6 gm., three times daily, had a very marked effect. The cardiac action became almost entirely regular. It was interrupted only by single auricular extrasystoles and very abortive runs of flutter. On one occasion full dosage of digitalis was followed by perfectly regular action; following a second course, the rhythm was normal except for occasional extrasystoles.

Case II.—Mrs. T., a middle-aged woman with marked hyperthyroidism, was believed on clinical examination, because of marked cardiac irregularity, to have auricular fibrillation. It is of interest that this same mistake was made as in Case I.

Because of the grave illness of the patient and the necessity for operation, no special studies could be made. Tracings were obtained showing several short runs of auricular flutter, such as those observed in Case I. This, however, was not the only type of arrhythmia present. In one continuous strip there were found isolated auricular premature contractions, a succession of premature contractions and short runs of auricular flutter. In one attack the mechanism changed from succession of extrasystoles over to what appeared to be the beginning of paroxysmal tachycardia. All these forms of arrhythmia were initiated by auricular premature contractions, which, judged by the tracings, originated in the same focus, or at least in the same neighborhood.

These cases appear to us to have special significance, because of the unexampled opportunity to observe the beginnings and endings of a form of auricular flutter. Whether or not they are identical in mechanism with the usual forms of auricular flutter we are unable to say, but we have found no reason for believing it to be different.

What has appeared to be of most interest in the tracings concerns the onsets of the paroxysms. The clinical relationships among the four types of arrhythmia—auricular premature contractions, paroxysmal auricular tachycardia, auricular flutter and

auricular fibrillation—have long been remarked. Numerous cases showing both isolated premature contractions and onsets of paroxysmal tachycardia have been studied. It is well known that in most of these cases the first beats of the paroxysms are identical, in so far as tracings are concerned, with the isolated premature beats. Paroxysmal tachycardia has been defined by some writers as a succession of extrasystoles—a conception that our present knowledge surely does not enable us to deny.

Up to the present time data have been lacking concerning the mode of onset of clinical auricular flutter. Experimentally it has been found to occur sometimes as an after-effect of rapid stimulation of auricular muscle. Occasionally it has occurred after a single stimulus, either mechanical or electrical, in tissue that was predisposed, probably as a result of manipulation.

In our clinical cases the importance of premature contractions in initiating flutter appears unmistakable. Smith and Moody[1] show tracings of auricular fibrillation induced in patients by forced breathing and epinephrin, in which the arrhythmia was initiated by extrasystoles. Under certain circumstances, in the same patients, extrasystoles only were obtained, and once, following the injection of physostigmin, auricular flutter occurred.

On the basis of facts such as have just been cited it is possible to construct an hypothesis in respect of the arrhythmias of auricular origin which may simplify somewhat our conceptions of these conditions. It should be emphasized that the validity of this hypothesis must await further observations, but at any rate it may be of service for the present. The chief assumption is that clinical arhythmias of auricular origin are usually initiated by the discharge of a premature excitation wave from an ectopic auricular focus. In otherwise healthy muscle a single extrasystole results. In a state of continued stimulation or hyperexcitability of the focus there is paroxysmal tachycardia. In circumstances under which certain properties of heart muscle may be altered locally (notably localized disturbance of the duration of the refractory period) circus movement may be set up following the premature beat, so that

[1] Arch. Int. Med., 1923, xxxii, 192.

auricular fibrillation or flutter occurs. Which of these ensues would depend, according to the theories of Lewis, on the relationship of refractory period to conductivity in the part of the auricular muscle involved. A normal beat excites the circus movement only when the muscle is in a highly fibrillary state.

The application of the conception we have presented, it seems to us, offers the basis for a simple rational classification of disturbances of cardiac mechanisms.

DISCUSSION ON THE PAPERS OF DRS. WOLFERTH AND HARVEY.

Dr. Joseph Sailer: This is an extremely interesting communication. I am impressed with the very inadequate knowledge we have so far obtained from the electrocardiograph. The amount of knowledge still to be obtained from that source, I believe, is very considerable, and I recall, something like a year ago, someone in the discussion of this subject said they thought all the knowledge we could obtain from the electrocardiogram had already been achieved—there was nothing more to learn. There is going to be a good deal more to learn. One of the most interesting features in this communication has been the theory that Dr. Wolferth has brought forward to explain the difference in these conditions, that is to say, we have a dislocation of the pacemaker, the dislocation starts by auricular premature contraction and the subsequent course of events depends upon the condition of the muscle. I would like to ask him what he means by the condition of the muscle? Whether it is the condition of the conducting fibers or the condition of the auricular or of the ventricular wall? It was not quite clear to me just what he did mean by that theory. I would like to say a word about the case of Mrs. T., the case alluded to by Dr. Wolferth as having been under my care. Mrs. T. has had a long and very varied medical history. I saw her first about fifteen years ago and I did not see her again until recently, when she had a well-developed case of hyperthyroidism with all the characteristic changes, except that the tachycardia, instead of being rhythmical, was exceedingly arrhythmical. She was bedfast at her home, and I had no opportunity of making electrocardiograph studies. I had her brought to the hospital, and did hazard the guess that the arrhythmia was due largely to auricular extrasystole, but I did not realize that we had such a complicated condition. Dr. Frazier ligated the superior thyroid arteries; the operation was successful, and when

she left the hospital her heart was apparently rhythmical. I did not know her tracings were made. The arrhythmia changed slowly from day to day, and the heart became more and more regular until it seemed to become entirely rhythmical about two days before she left. I have been hoping to see her; she is doing well and her physician has not sent her in for further study. Auricular flutter is pretty well known; the diagnosis is made with great difficulty, except by the aid of the electrocardiograph. I do not think I have ever made a clinical diagnosis. I have seen fewer cases than Dr. Wolferth. It does not seem to be a condition which seriously menaces life under any conditions. I had a case, a man over sixty years of age, who finally died of pneumonia. He was aggressive, active, and would get a little short of breath climbing stairs, had edema of the feet, a perfectly enormous heart, but, so far as I could see, during these three years, excepting for occasional attacks of very severe decompensation, which were always brought on by excessive activity, either physical or mental, he remained quite as well at the end of the third year as he was at the beginning of his illness. Apparently the persistent flutter, which never changed, was in no way injurious to the efficiency of the circulation. Dr. Wolferth has said the association between these cases of temporary flutter, lasting for only a few beats in the first case and the periods in the second, might have been regarded as paroxysmal tachycardia if they had lasted longer. I do not see how he can determine that three beats of paroxysmal tachycardia are not just as satisfactory for establishing diagnosis as are three beats of auricular flutter. The cases have something in common; just what that thing in common is I do not know. I would mention briefly a case of similar type I saw recently. I was called to see an old lady eighty years of age, with a pulse of 240, running at that rate, her physician told me, for two or three days. There had been repeated attacks of these violent palpitations which before had never lasted so long. She had orthopnea, and considering her age, her state was alarming. I suggested pituitrin, and the first dose definitely checked the tachycardia. The pulse returned to natural rhythm. There was naturally no electrocardiogram taken. If I had known what the case was likely to have been I think I would have taken a polygraph along. Unfortunately she was so promptly relieved that it did not seem worth while to take any further tracings of her case. I do not know just what effect pituitrin might have on these cases. It seems to be harmless. If I have opportunity to study any of these three types I shall try to take the tracing before and after the injection. I want to congratulate Dr. Wolferth on presenting a new study in our electrocardiographic work.

Dr. S. Calvin Smith: I feel that we all have a better understanding of that rare heart irregularity called auricular flutter after hearing the excellent papers of Drs. Wolferth and Harvey.

Auricular flutter is not a frequent heart abnormality, and as it has no definite clinical signs it is not often recognized by the practising physician; indeed, it cannot be recognized except by electrocardiography. In my experience auricular flutter occurs in young adults rather than in persons of middle age. It is not found in people who are particularly concerned about their hearts, for there are no signs to draw special attention to that organ other than exhaustion and fatigue, which the young attribute to physical effort or excessive emotion. In this way auricular flutter differs from other irregularities, such as premature systoles and auricular fibrillation, either of which will send the one afflicted to the physician on account of an irregular pulse, precordial sensations, etc.

The clinical value of recognizing auricular flutter is on account of the effect which digitalis will have on this irregularity. Digitalis will change auricular flutter to auricular fibrillation, after which normal rhythm ensues; this sequence of events I have also observed without the use of digitalis or any other drug.

The hypothesis which Dr. Wolferth elaborated seems to me to be very valuable from a clinical standpoint. It shows that the auricular premature systole can be the beginning of profound and serious heart muscle disturbance, and the hypothesis should teach us that there is actual danger in dismissing a patient with the statement "she only has extrasystoles."

I would like to ask Dr. Wolferth what was the underlying cause of the auricular flutter in the patient whom he has described?

Dr. James E. Talley: I heartily subscribe to Dr. Wolferth's theory concerning the relationship of these various irregularities. We have all seen auricular fibrillation pass to auricular flutter under the influence of quinidine, ordinarily to end in a return of sinus rhythm, but occasionally the flutter persists. We have curves where simple tachycardia has passed into auricular fibrillation with a return to the rapid sinus rhythm more than once. Furthermore, we must remember that the wave of excitation is responsible for all of them. Flutter may be broken up by other influences than drugs. One patient with flutter of at least a year's duration lost it entirely during a sharp attack of influenza with high fever, but in some months the flutter returned. We shall hope that the electrocardiographic method is not yet exhausted, but that we are simply stopping a bit to weld together what has already been obtained. It must be all of ten years ago that Parkinson reported a case of simple

paroxysmal tachycardia in a child five years of age. At that time someone hazarded the suggestion that an "embryonal rest" similar to sino-auricular tissue might be the birthplace of the impulse formation. More recently there is evidence that perhaps the microanatomists are catching up with the physiologists and experimenters. Van der Stricht and Todd, in 1919, and Holmes, in 1921, succeeded in demonstrating Purkinje fibers in the auricular wall.

Dr. Wolferth (closing): In answer to Dr. Sailer's question as to what is meant by "condition of the muscle," my remarks refer exclusively to the condition of auricular muscle. It is alteration from the normal of one or more of the properties of auricular muscle that paves the way for the arrhythmias of auricular origin. Extrasystoles and paroxysmal tachycardias, we refer (possibly incorrectly) to disturbance in excitability. Auricular flutter and fibrillation probably owe their origin to either momentary localized prolongation of the refractory period or intra-auricular block. In the cases we present, the flutter invariably took its origin from an extrasystole. At the time of these premature beats conduction and the refractory period have had but a short time for recovery, and it would not be surprising to find them depressed, so that an excitation wave in the auricle might find its path blocked in certain directions. Thus in a heart predisposed to flutter or fibrillation it is not difficult to offer a view as to how extrasystoles initiate the arrhythmia.

I am very much interested in Dr. Sailer's observations on the effect of pituitrin. I know of no other remedy from which one might expect such favorable results. I am not at all familiar with the effect of pituitrin in these conditions. I think it would be well worth investigating further.

In answer to Dr. Smith's question, Dr. Sailer has given us the subsequent clinical history so far as known in the second patient. The first patient was a more or less ignorant foreigner, who spoke very little English. We were able to follow him for a few weeks while he was under the effect of digitalis. During this time he had occasional extrasystoles. Subsequently we lost sight of him and I do not know what his present condition is.

Hemophilia, with Report of Three Cases

BY ROLAND N. KLEMMER, M.D.

Definition. Hemophilia is a hereditary disease of the blood in which the coagulation time is typically greatly lengthened. It

is characterized by (1) a tendency to uncontrollable external hemorrhage which rarely is spontaneous, but usually follows trauma which may be only slight, and (2) internal hemorrhage resulting in mammoth hematomas and joint symptoms after minor injuries, due to hemorrhage into the joint cavities, most frequently the knee and elbow. The disease is limited to the male but transmitted by the female. It has been recognized since the earliest days of medicine, but the first description of the disease was given by Otto, Philadelphia, in 1803. He also first used the term of "bleeder."

Findings in the Blood. Thus far only two positive findings in the blood in hemophilia have been discovered. They are: (1) The coagulation time is prolonged; and (2) the prothrombin time is abnormally long, or, in other words, the formation of thrombin is slow. The coagulation time in normal persons, depending on the various methods of its estimation, ranges from about five to thirty minutes. In hemophilia it may be prolonged to three or four hours. The prothrombin time in normal persons, according to Howell, ranges from nine to twelve minutes, but in hemophiliacs may vary from two to five hours.

The negative blood findings are also important. The red and white corpuscles and the platelets are normal in number and appearance. The fibrinogen is normal in amount and is readily coagulated by thrombin. The bleeding time, as described by Duke, is normal. The blood clot in hemophilia is firm and retracts in the normal manner. No lack of calcium salts in the blood is demonstrable.

Explanatory Hypotheses. All modern work has shown that the addition of tissue extract to hemophiliac blood markedly hastens coagulation. To explain all these phenomena of hemophilia there are various hypotheses. There are two main theories in explanation of blood-clotting in general, both agreeing that thrombin acts on fibrinogen to produce fibrin, but differing on the mode of formation of the thrombin.

1. According to Morawitz, thrombin is formed by the interaction of calcium salts, thrombogen and thrombokinase. Cal-

cium salts and thrombogen are contained in the plasma. The third factor, thrombokinase, which is the specific substance in the tissue extract mentioned above, Morawitz believes is contained in the platelets. Sahli regards the thrombokinase as originating mainly from the cells of the bloodvessel walls.

2. Howell's theory of blood coagulation goes a step further than that of Morawitz. He believes that in the circulating blood are found calcium salts, prothrombin and antithrombin, and that when the substance contained in the tissue extract, which he calls thromboplastin, is liberated, it neutralizes the antithrombin, hence releasing prothrombin, which immediately reacts with the calcium salts to form thrombin. Howell, himself, believes that in hemophilia there is a quantitative defect in this prothrombin, while Addis believes that the defect in prothrombin is qualitative. However, since prothrombin is supposed to be derived from the platelets, all these theories seem to point toward a qualitative defect in the platelets. Moreover, Minot and Lee have found that "If normal platelets in about normal amounts were added to hemophiliac plasma they caused coagulation in normal or nearly normal time. But when hemophiliac platelets were added to hemophiliac plasma even in seventy-five times as great a concentration as in normal blood, though they definitely shortened coagulation time, they never brought it to anything approaching normal." This would also point toward a platelet defect.

Differential Diagnosis. The main points in the symptomatology of the disease have been embodied in its definition above, but I would briefly consider the differential diagnosis. Evident though it usually is, a number of fatalities have occurred because of operation under mistaken diagnoses. There is usually obtainable a family history of bleeding in the males. Hemophilia should always be suspected in sudden joint effusions and particularly in such cases which give also a history of bleeding from infancy. The disease with which hemophilia is most often confused is purpura hemorrhagica. In the latter the blood platelets are much diminished while in hemophilia they are normal in number. Purpura shows a normal coagulation time and is rarely heredi-

tary. The application of a tourniquet to the upper arm for a few minutes, according to Hess, produces minute petechiæ in purpura, but not in hemophilia (capillary resistance test) and subcutaneous puncture of the skin in hemophilia rarely produces a hemorrhagic area, while in purpura such is the rule.

The only other diseases which give so prolonged a coagulation time as hemophilia are some cases of hemorrhagic disease of the newborn and certain cases of prolonged jaundice. Hemophilia differs from hemorrhagic disease of the newborn in family history. The hemophiliac baby seldom bleeds from the umbilicus; he rarely has melena and the onset of his disease is later than that of hemorrhagic disease of the newborn.

Treatment. In the treatment of hemophiliac bleeding in the acute stage the generally recognized styptics, such as adrenalin, tannic acid, etc., are useless. Calcium salts are of no benefit. External hemorrhage is best treated by perfect cleansing followed by blood serums, fresh tissues or extracts of fresh tissues applied locally to the bleeding point. It may be necessary in hematomas, *e. g.*, from penetrating wounds, to open the hematoma, remove the clot and apply a serum dressing.

Internal hemorrhage may be treated by the subcutaneous or intravenous injection of 20 to 30 cc of human serum. In very obstinate cases whole blood transfusion of 100 to 500 cc is best.

Preventive treatment includes general hygienic care, but especially protection of patients from all sorts of trauma. Weil reports excellent results along the line of permanent cure or "near cure" by subcutaneous injection of 20 cc of serum every two months for extended periods, gradually lengthening the intervals between injections before stopping completely. By this method he claims that he has not had a fatality in his series of over 50 cases. He also uses the serum treatment as a preparation for minor operations, using 20 to 30 cc one or more days before operation and repeating at the time of operation. More severe operations may be carried out successfully by preceding and following them by transfusions of whole blood.

Report of Cases. Dr. Riesman has very kindly given us notes on 2 cases of hemophilia, brothers, whom he saw in private practice in 1912. They were store clerks by occupation and aged respectively twenty-one and twenty-four years. Both had swelling of the left knee-joint with more or less crepitation. In 1 of them there was inability to entirely extend the left leg and wasting of the thigh muscles. Both were said to have bled very severely after circumcision, and very frequently trivial injuries had resulted in prolonged bleeding. Two maternal uncles bled to death after circumcision. There was no history of bleeding on the paternal side. The patients had one brother and two sisters who were not bleeders.

The third case is very interesting from the diagnostic side. He has had seven admissions to the Philadelphia General Hospital. At the first, in 1919, when he was thirty-five years of age, a diagnosis of syphilis was made. The following year he was readmitted for vertigo, insomnia and headache.

While in the hospital at this second admission he bumped his right knee and the following day it became extremely swollen and very painful. It was neither hot nor red. Eight days later 30 cc of blood were aspirated with much relief. A roentgenogram showed osteoarthritis of the right knee and periostitis of the middle and lower thirds of the femur. The Wassermann reaction was positive, and the patient was given five intravenous injections of arsenobenzol. The right knee gradually became stiff and contractures set in which in time became so pronounced that three months after the onset of the swelling the following consultation notes were written by an orthopedic surgeon: "Specific arthritis of the right knee, with contracture. Tenotomies of hamstrings and forcible correction suggested." The patient refused operation and spontaneous absorption took place, until at present there is only slight limitation of extension.

The patient was readmitted the next year, following a blow on the jaw, and a tender fluctuating mass found. Believing the mass to be an abscess, it was opened and only then discovered to be a hematoma. The patient bled from this wound for six

days and was almost exsanguinated before the hemorrhage was controlled. This operation was performed in spite of an admission history of severe bleeding from an injury to the nose sixteen years before, and also severe bleeding after teeth extraction and from a mashed toe eight and seven years previously, respectively.

During the following three years he was admitted three times, each time for large hematomas of the thighs following trauma of moderate severity. Each time the hematomas were absorbed and the patient discharged in good condition in about a month.

Five days before his last admission an artillery shell rolled on his left great toe and this subsequently began to bleed profusely while he was walking. On admission he presented the appearance of a well-developed and powerful man aged thirty-nine years. The bleeding came from a small ruptured hematoma beneath the nail of his left great toe. He was unable to completely extend the right knee.

The bleeding from the toe was controlled without difficulty at the hospital, although during the next ten days it recurred several times, always yielding, however, to compresses saturated in normal horse serum applied locally.

With regard to his family history, he said that a full brother died in the Samaritan Hospital, Philadelphia, from hemorrhage following an operation on his kidney. The son of the patient's half-sister, on the maternal side, is a bleeder. A number of full and half-brothers and sisters are not bleeders.

During his stay in the hospital the patient complained of continuous insomnia, with occasional headache, and on one occasion had a hysterical outbreak during which he broke up several beds and threatened to kill someone if his headaches were not relieved. By gradually increasing the dosage of paraldehyde it was found that 5 drams were necessary before he would admit that he had obtained any sleep at night, and this dose was given on six successive nights. Roentgenographic examinations of his head were slightly suggestive of intracranial pressure, but there were no signs of cerebral lesion. We would consider the possibility of an intracranial hematoma to account for his symptoms. He was

discharged, relieved in large measure of the headache, but still complaining bitterly of insomnia, and we have been unable to trace him because he has not communicated with his family in Philadelphia at any time since his discharge.

Three cases of adult hemophilia are reported, all of whom had permanent knee-joint changes. In none was the diagnosis of hemarthrosis made during the acute stage of joint involvement, in spite of an easily obtainable family history of bleeding and of previous serious hemorrhages in the individuals themselves.

In these two hemophiliac families in three generations, out of 7 bleeders 6 submitted to surgical procedures, which resulted in 3 deaths and 3 severe hemorrhages. The importance of including a few questions on hemophilia in the routine surgical history cannot be too strongly emphasized.

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DISCUSSION

Dr. David Riesman: Dr. Klemmer has given us a very concise outline of the essentials of this most interesting subject. From the point of view of biology, hemophilia can scarcely be excelled. Dr. Klemmer suggested in the conclusion of his paper that we should ask questions of cases to be treated surgically, whether there is any hemophilic strain in the family. This reminds me of the point made by Dr. Davenport, the eugenist that such questions should be asked of all alien immigrant women. Undoubtedly all the bleeders in this country—and there are a good many bleeder families—must have come from the other side. There is a bleeder family in Sullivan County, Pennsylvania, which is interesting in one respect: The members are nine-day bleeders, that is, if an injury is sustained the individual will bleed from the wound for

nine days, then a clot will form, apparently a good clot, and then in about nine days the bleeding starts again and continues for about two weeks.

Hemophilia is a very startling illustration of a peculiar type of heredity—the disease is found only in males but is transmitted by females. There are a good many cases of female bleeders reported, but those who have gone into the literature most carefully have thrown all of them out on pretty good evidence. In other words, there appears to be no authentic case of a female bleeder. That is difficult to explain on the known laws of heredity. It is generally held that hemophilia is inherited according to the Mendelian law—that it is dominant in the male and recessive in the female, and therefore does not appear in the female.

There are, however, many interesting questions that remain unanswered. For example, Why is it when the two parents are of bleeder stock the daughters should be normal? We cannot explain this on the recession theory. I cannot go into the actual explanation because it is too technical and involved. It seems hemophilia is linked to the chromosome and at the same time is also linked to some lethal factor which kills the ovum that would develop into the bleeder female, so that all females are born normal. They are, however, conductors and transmit the disease to their sons, and these are bleeders, and if they have male and female progeny they will have healthy sons who will have healthy children, but the daughters will have bleeder sons who will again have healthy sons and conductor daughters. It is certainly a very interesting subject from the standpoint of genetics.

I want to say a word about some other diseases that belong to the same group. There is an hereditary telangiectasia in which sometimes the bleeding is fatal. Then there is an hereditary epistaxis running through families. Libman, of New York, has recorded a family with heredity hemoptysis. The field of these hereditary diseases is widening.

Quite recently a very interesting matter, not pertaining to hemophilia but connected with the subject of heredity, came to my notice. A doctor brought his sister, a resident of Boston and a "Mayflower" descendant, who traced her family history back for over two hundred years. In that two hundred years there had been twenty-three sets of twins, none ever on the male side; all the twins have been on the female side. Another anomaly, polydactylism, six-fingers, is carried down according to the Mendelian law. In France there is a little village, entirely away from the highway—in time through intermarriage the whole village practically was six-fingered. A high road was carried through which opened the village to civlization, and within a comparatively short time normal fingers appeared in the children.

I have been following for some years an anomaly of the thumb which for want of a better term I have called foreshortening of the thumb. It is usually bilateral, but may be unilateral. It is distinctly hereditary.

The other day a doctor brought his daughter to the office. I looked at her feet and found she was web-footed. I called the father's attention to the fact and was informed by him that he was web-footed.

There is another defect very intensively inherited, namely, the bony prominence that sometimes develops on the hard palate. It may be as much as half an inch thick and an inch or an inch and a half long. The patient rarely knows that he has it. Usually several members of the family are affected in the same way. I have not had time to trace any Mendelian type in it, but it seems to me there must be. I think if we physicians took a little note of these things we would perhaps contribute something to the scant knowledge of human heredity.

Dr. W. H. Stoner: It appears that terminology lends to our profession a certain degree of satisfaction. When a new idea, a new disease, or a new substance, either real or hypothetical, is given a name, preferably Greek or Latin, many take comfort in the advance that has been made in the knowledge of the subject concerned. Probably no better illustration can be chosen than the subject of blood-clotting. The artificial terminology introduced into this subject, largely by the serologist, has led to confusion which could be avoided by a careful definition of terms. Mal-logic of medicine is largely due to deficiency of definitions.

Thirty to forty histological structures and substances, real and hypothetical, have been proposed as the seat of the essential pathology of hemophilia. And each of these theories has been contradicted. The biochemist recognizes the great probability of error in a theory based upon the activities of hypothetical substances, as thrombokinase, prothrombin, alphaprothrombin, antithrombin, antiprothrombin, metathrombin, etc. The more credulous physician, on the other hand, in his laudable eagerness to be progressive, is prone to accept the current theories, shifting from one to another as they are perpetrated. The current theories of hemophilia appear to center upon the thrombokinase and the blood platelets and to be unsupported by convincing experimental data.

The differential diagnosis of purpura and hemophilia appears to be so difficult and subtle as to suggest the possibility of their being different degrees or differing manifestations of the same underlying inherited pathological conditions. It is difficult to disprove this. Since the diagnosis of hemophilia is based mainly upon, first, platelet count, the normals of which, as given by different authorities, vary nearly 300 per cent, and, second, the coagulation time, which varies normally 500 per

cent by different technic, it is not surprising that Paul Morawitz, the greatest authority on this subject, states that less than 15 per cent of the cases reported are true hemophiliacs. It is seen, therefore, that the condition is extremely rare. Dr. Riesman is very fortunate to have observed three cases in twelve years.

Let us recognize frankly that we know but little more concerning hemophilia than is contained in the etymology of the term. Unfortunate is he who is satisfied that he is on the right track through the dark forest of medical terminology, because he can lisp the Latin or Greek names of some of the trees that obstruct the light.

FEBRUARY 25

Some Notes on the Treatment of the Common Functional Nervous Diseases

BY WILLIAM DRAYTON, JR., M.D.

Are we neglecting the treatment of the functional neuroses and the various common nervous disorders which are becoming more and more frequent, largely due to the complexity of our lives in the big cities and to the smattering of inaccuracies concerning medicine and medical matters possessed by the general public? If the answer is: No, we are not neglecting these all-prevalent disorders, the next question we should ask ourselves is: Why, then, are there so many quacks, neuropaths, osteopaths, faith-healers, spiritists, etc., to whom the laity turn when relief is not obtained from their regular physician?

One's answer might be: Oh, it is the chronic, incurable cases that go to them because they are willing to try anything new and mysterious, and their physicians have told them that they are incurable; so, in despair, they turn to the quack doctor who promises much.

But, you say, this class of patients is not cured by the quack and many cases do get relief who visit the faith curist or chiropractic—what of them?

The answer is: The patients suffering with functional neuroses make up the great believers in the various cults and fads which are so prevalent at this time.

Now, how do these healers produce cures when we regular physicians have failed? Largely by the power of suggestion, making much of the ailment and employing new and mysterious methods of treatment.

One asks: Is this the only way these cases can be handled? No, though a large number of patients can only be cured by suggestion and that suggestion which is most appealing to their peculiar type of mind. If they be intensely religious the laying on of hands with a mumbled prayer, or the viewing of a sacred relic with absolute faith in the result, will produce a cure of the symptoms which trouble them.

But there is another method which will produce a more lasting recovery among the more intelligent of our patients: A thorough investigation of their lives, environment, business, school, home and domestic difficulties may give us the clue to the cause of their ailment, for these functional disorders all have a cause. Then by explanation and reëducation how to live and how to solve the troublesome conflict which has produced the functional neurosis, the neurosis will disappear and the patient will once more be well.

To explain just what is meant by this, I will quote a few cases which have come to my notice.

Case I.—A young woman, aged twenty-six years, with a violent persistent headache. This young woman had gone to many physicians and surgeons. Her round ligaments had been shortened and a dilatation performed; tonsils removed; eyes refracted; septum straightened; teeth extracted; various minor operations performed, such as draining sinuses, etc. Her headaches persisted in violence and frequency. Her history is as follows: She was adopted by a man and wife who had lost their only child; she was reared with care and attention, but not allowed to bring friends to the house or to be away from home at any time. She

was constantly shielded in every way. As her own mother's character was not above reproach, the adopting mother determined that no harm should befall her. About Christmas, 1922, she discovered that she was adopted; her mother's evil deeds were told her; her adopting mother began to tell her that she should be so grateful for all that had been done for her that she should stay at home all the time and try to repay the kindness and attention lavished upon her. The girl rebelled, but was kept in more and more. Her headaches necessitated a physician's attention; indeed, she could only get out of the house to go to a doctor or a dentist, and she went daily. When these facts were ascertained a new life was mapped out for the girl, and dancing lessons, swimming lessons, a girls' club and various occupations were prescribed. Her headaches disappeared, as they were no longer necessary to her. She was well.

Case II.—A woman with severe palpitation, pains about the heart, shortness of breath, with a tendency to faint. These symptoms kept her husband constantly worried and a constant attendant at his wife's couch or bedside. Her heart was normal, but she was jealous, afraid that she would lose her husband, and so these means were taken to keep him at home. When the cause was discovered a long talk with wife and husband followed; coöperation on his part was obtained and the cardiac symptoms disappeared.

Case III.—An extremely religious woman after a severe illness developed the following symptoms each time she went to church: Flushed face; cold, chilly sensations; trembling and an urgent desire to get up and leave; this desire was so overwhelming that if it was resisted she went through extreme mental tortures. If yielded to, intense embarrassment. The origin of the mental symptoms was found to be as follows: Her father was extremely religious and demanded that his daughter accompany him to church each Sunday; the pew that they occupied was in the front of the church. The daughter developed a cystitis at about

the age of thirteen years, just at a time when she was most self-conscious and shy; the hours of service, as may be imagined, were torture to her, both physical and mental. Shall I stay in and suffer or walk the length of the aisle facing the stares of the congregation? Her cystitis recovered. But later, after the illness, the situation being exactly reproduced, she went through the mental tortures previously experienced, but naturally did not refer them to the original incident.

Case IV.—A man who in infancy had synovitis of the right knee with a consequent temporary crippling, which was repeated many times, due to football injuries, had always been warned by his mother to be careful of his knee, and was constantly guarding against injury. During the war he was going toward the front and received a bullet wound in his right calf. The wound was dressed. Returning to the rear, when he was knocked unconscious by a shell, he came to in the dressing station with his right leg bent up under him. The leg remained bent and he walked on crutches for two years. A surgeon was about to amputate at the knee, as the leg was useless, the right foot being so far drawn up that it touched the buttock. Sir Robert Jones, the orthopedic surgeon, saw him, and, recognizing that the trouble was purely functional, referred him to a neurological hospital, when after a few hours' talk and explanation of the whys and wherefores his leg was straightened out and he walks once more. His remark on recovery was, "Why has no one ever treated my mind? All the attention was paid to my leg when it was my mind that was ill."

Violent tempers, rages, fears, dreads and many physical symptoms, such as palpitation, diarrhea, vomiting, vertigo, etc., can all be relieved in the same way—discovering the origin of the symptom or necessity for the symptoms, talking it over with the patient, helping them to solve their conflicts, readjust their lives and reëducating them on how to live. The patient recovers and is far less apt to relapse. Whereas with suggestion the relief is only for the immediate symptoms.

When is suggestion to be employed and what type of suggestion shall we use and when a mental exploration with reëducation, etc.? That will depend entirely on the patient's mentality. No fixed rule may be laid down, but careful personality studies will usually influence our choice of method.

When it is decided that the patient's mentality does not permit of mental exploration and reëducation, but an immediate suggestive treatment of some sort is deemed advisable, what form of suggestion shall we try?

Shall we use elixir of valerianate of ammonica, which depends on its foul odor for its suggestive properties; the static current, which depends on its crackling sparks and the tingling sensations produced through the patient's body; shall we prescribe, as was frequently done by Dr. Weir Mitchell, 1 drop of aqua destillata, to be dropped with extreme care in a tumbler of water and given twenty minutes after meals? (The patient was told at the time that if by any chance two drops of this potent medicine were put in the glass the dose was to be thrown away and another drop was to be dropped into a fresh tumbler of water.) I remember a city fireman who was suffering from a multiplicity of ills for whom this was prescribed. He went out of town for a time and one Friday evening I found him on my doorstep, trembling with anxiety. He said, "Doctor, my medicine is gone, the hospital clinic will not be open till Monday. I have had no medicine today and have been very ill in consequence. Please renew it as I cannot stand the suffering." I told him what he had been taking—one drop of pure distilled water, how he had been suffering with self-suggested ills and curing himself by suggestion. He was at first incredulous, then angry with us at the hospital, then a great light came to him. He said, "I am a dammed fool, and I will kick myself for a week; but I am cured." He came back later and reported a complete recovery. However, it does not always pay to tell our patients of the suggestion that has been practised on them, as frequently suggestion must be used again and the patient becomes suspicious of any therapy employed.

Many people think that the foregoing exploratory method was

devised by Freud and Jung and men of that school, but though they may have been the first to describe what they termed psychoanalysis, and supplied most of the modern and oftentimes incomprehensible nomenclature, the same treatment was used by Dr. S. Weir Mitchell in many, many cases, and I feel sure that it has been used by most neurologists and psychiatrists before and since, even those who most object to the teachings of Freud and men of his school.

Mental exploration, having the patient fully describe past and often painful experiences, in which there were great emotional disturbances, frequently produces the clue to the ills of the present. Helping them solve their mental conflicts, discussing their worries and trials, adjusting their lives so that they may live in more peace and happiness with those about them, will usually do much to help clear up the neurosis from which they suffer.

As we are more successful in treating physical ills when we know the cause, so can we more intelligently treat the many ills of the mind if the factors leading up to them are discovered.

DISCUSSION

Dr. Edward A. Strecker: There is really very little to add to the excellent presentation given by Dr. Drayton. All I can hope to do is to try to resay some of the things he said and perhaps in this way emphasize them. In the first place there is a common fallacy, which creeps in all the time and distorts our conception of the functional nervous disorders. That fallacy is a kind of "all or none" theory, and it assumes in effect that there is a kind of chemical incompatibility between somatic disease and a neurosis, so that, for instance, the individual who develops a neurasthenia is automatically protected from the development of some physical disease. This assumption has a reverse side to it which states that the presence of pathology within the body makes the development of a neurosis impossible. I think a neurosis may be fairly defined as a faulty response to some of the difficulties which life offers. Now it is obvious that in many instances these difficulties are psychic; it is equally true that they may and often are somatic, and it is probably true in the majority of instances that they consist of various combinations of psychogenic, somatic, social and environmental difficulties. In the clinic of the Pennsylvania Hospital, where there are a great many examples of

common neuroses seen, it is routine to insist upon a thorough examination and thorough laboratory studies, and in about 50 per cent of the cases the presence of physical disease is discovered—tuberculosis, syphilis, arteriosclerosis, cardiorenal disease, focal infection, endocrine dysfunction, etc. Now what does this organic morbidity mean? Does it mean that here is the pathology of psychasthenia, or neurasthenia, or hysteria? Not at all. It does mean that here is a factor which any physician who sees patients suffering from functional nervous disorders cannot afford to neglect. I would say that the first suggestion concerning the diagnosis of common neuroses is that the physician free his mind about any preconceived ideas about the separation of so-called organic and functional, and regard the patient as something to be explored and examined and expect to find not only psychological deviations, but various pathological conditions. Of course, you all know that in 80 to 90 per cent of various physical diseases at some point in the course of the ailment certain neurotic ailments are likely to make their appearance. You know that convalescents can be divided into two groups: Those wanting to go back to work too soon, and a somewhat larger group which either consciously or unconsciously retain a certain number of their symptoms because they are unable to make quickly that adjustment between being sick and getting well. For instance, a physician who sees in any disease, as, for instance, typhoid fever, only a disease which affects the body of the patient and does not involve the mind, if he is only going to treat what he can palpate and percuss and what he can see under the microscope, that physician is going to be very often disappointed and nonplussed in his treatment of the patient.

Now in regard to the treatment of the functional nervous disorders: I said, in the first place, that there can be no universal plan which has a common application to all the neuroses, or even to two cases. For instance, no two cases of neurasthenia could be treated in the same way. Not only do they differ as individual reactions, but every physician who treats these conditions has certain resources of his own which he knows of which are different from the resources of some other physician. The point is he should use the resources which he is best able to use. It is probably true that the great efficiency of the Weir Mitchell rest-cure was not in the excellent technic, but in the remarkable personality of Weir Mitchell. I think everyone recognizes that today. The principal objection to the treatment by means of Freudian psychoanalysis is not in the body of the doctrine but lies in the fact that Freud has described a certain rigid cut-and-dried method of treating neurotic patients, which he insists should not be deviated from. I think this is the chief objection to the treatment by the method of Freud. However,

we have to have some sort of an orderly procedure in the treatment of functional neuroses. The first step is the history, which should be thorough. There is no field in the history of medicine in which we must be as thorough as in neurology. In the first place we have no instruments of precision to look into the mind and soul, nor can we take specimens of phobias and place them under the microscope. We must start with history, and every patient is entitled to be given enough time for a thorough historical review of his life and of the development of the neurosis. I heard it said by one of the noted ophthalmologists of this country that one of the reasons for his great success was that he was so thorough and painstaking in taking the history; he made every patient feel, for instance, a patient with cataract, that never was there such an interesting cataract, nor never was there one which deserved more careful attention. The next step in the treatment of common neuroses—the treatment begins from the first time the patient meets the physician—is the physical examination. There are two good reasons why the physical examination should be very thorough. Valuable information is to be gained if modern methods of diagnosis are taken advantage of; the second point is that it gives the physician an overwhelming advantage. The physician who makes his examinations piecemeal, from time to time, is never sure of his ground. Every time the neurotic patient complains of some particular symptom, for instance a heart symptom, the physician must be uncertain in his mind because he has not made a thorough examination. All this makes a bad impression on the patient, a very bad psychotherapeutic impression. So the examination at the beginning should be thorough, and the physician should stand pat on what he finds. The next point would be the diagnosis. Now I should say that the calling of names does not constitute a diagnosis; calling a patient a name does not help to cure him, so the mere fact that the neurologist is able to say in a few minutes that this is a case of neurasthenia or hysteria does not mean anything to the patient. If back of this word diagnosis there is in the mind of the physician a clear conception of the events which led to the neurosis, then it will carry with it treatment ideas which will be effective. In regard to physical therapy—I mean rest in bed, massage, occupational therapy, electrotherapy, etc.—I think these things should never be prescribed in general terms. They must be prescribed with the same exactitude that you prescribe a hypodermic injection of morphine. Simply to say to the nurse, "The patient can begin to walk now," is of no service; but to say "Tomorrow the patient can walk exactly five minutes," is a very good plan, and has a good effect on the patient. Now what about psychotherapy? It is an effort to understand the mind of the patient, to get some idea of the

mechanism which has been translated into certain symptoms which are present. I think every physician should take stock of his own resources and develop a psychotherapeutic approach which takes advantage of his own abilities. I think it is a mistake to be in a hurry, to try to probe the so-called subconscious mind too quickly—to start immediately on association and dream analysis. I think in the great majority of cases everything needed to cure the patient can be gotten from the conscious mind. I think it is more desirable to get it in this way than to explore the unconscious mind of the patient, because if you do that you often get a great deal of material which is not needed and complicates matters. Psychotherapy will be successful in the proportion with which it meets these two basic conditions. The first is, Does the patient have confidence in the ability of the physician to get him well? The second is, Does the physician have confidence in his own ability to get the patient well? If these two conditions are present I think any reasonable method of psychotherapy will be attended with a great deal of success. There is one other point to be added. Dr. Drayton indicated it. It might be called social medicine. If the physician feels it is not any of his business to inquire into the environment of the patient, for instance the home situation, then he had better not treat the neuroses. Many a hysteria in neurasthenia has its roots in a bad family situation. Unless the physician is willing to be called a "busybody," to find out about the extraneous difficulties of the patient, and to make an effort to adjust them, then he is not going to cure his patient permanently. The hysteria or neurasthenia will continue to recur throughout the life of the individual.

Dr. A. J. Ostheimer: I have had more or less experience in observing and treating ex-service men suffering from the psychoneuroses, as I went into the army in 1917, and for the past four years have been with the U. S. Veterans' Bureau in this particular part of the work. You probably know that about 60 per cent of all the men suffering from all functional or organic nervous diseases in this particular district, which includes Pennsylvania and Delaware, have been suffering from so-called "shell shock," which, of course, means, in technical terms, from the psychoneuroses.

Of course, the treatment of these ex-service men is a very different thing from that just described by Dr. Drayton. These men do not have to pay the doctor nor do they often wish to get well. Their tendency is not to be cured in order that they may draw compensation from the Government as long as they are ill. There are, of course, notable exceptions to this rule.

As far as diagnosis is concerned, there is, of course, only one thing to

do, and that is to eliminate the existence of organic nervous disease and at times also, the existence of an actual psychosis, by a very careful examination. It is often most difficult to differentiate between a psychoneurosis and an actual organic condition. I believe a thoroughly complete social history, the individual history of a man's whole life from the earliest childhood up to the time of the examination, is most important. Such a history should include not only the history of the disease but also complete information as to social conditions, work, play and religion, *i. e.*, every individual item that played a part in the man's life, whether it be from the mental or physical standpoint, for after all one supplements and complements the other. Man is not wholly mental or wholly physical. It is not of consequence whether matter affects mind or whether mind affects matter; it does not make any difference one way or the other. One should consider the man, the personality as an integrated whole.

As to treatment, it seems to me that the essence of it is psychotherapy, as Dr. Strecker has pointed out; it is the ability of the doctor to get his own personality, if he has one, over to the patient. If he has a good, strong personality he can get results by autosuggestion and suggestion, which make up psychotherapy.

Do not understand me to mean that a complete physical examination and treatment of structural changes consequent upon any toxic condition or endocrine disturbance are not of the greatest importance. They are—in just the same way as they are necessary in the case of similar patients who may not be suffering from a psychoneurosis at all. Those who become psychoneurotic are the individuals who have been laboring ever since birth under the load of some defective anlage or whose nervous system has been structurally damaged by disease.

Suggestions Regarding the Diagnosis of the More Common Nervous Diseases

BY S. F. GILPIN, M.D.

(*Abstract*)

Early diagnosis only is considered in the paper because of its great importance. Headache, which may be the first symptom in brain tumor, should not, because it is intermittent in character

and accompanies no physical signs in the patient, be considered always as functional or toxic. In a short time reëxamination may reveal organic disease of the brain. Because of increased intracranial pressure and the presence of the tumor, symptoms are often referred to other parts of the brain and may mislead us in localization. Ventriculography is often of great assistance in localization, but of some risk to the patient. The Bárány test is of great value in localization of cerebellopontine angle lesions, but otherwise the interpretation may lead us astray in localization.

Tumors of the spinal cord must be differentiated from multiple sclerosis, from pressure myelitis, from degenerative lesions of the cord in pernicious anemia, from transverse myelitis and from specific meningomyelitis. Study of the spinal fluid and *x*-ray study of the vertebræ are of great aid in diagnosis. Care should be taken that we do not locate the tumor too high in the cord.

In cases of epidemic encephalitis we should remember that the mildest cases may be followed by severe organic disturbance of the basal ganglia. Patients with sudden attacks of vertigo and double vision, with a temperature below 100° F. and with marked prostration, should be looked upon as possible mild cases and rested in bed until all symptoms are cleared up, in order, if possible, to avoid the distressing sequelæ. Differential diagnosis between some cases of encephalitis and tuberculous meningitis may be very difficult, and may be made certain at times only by laboratory tests.

Syphilis of the nervous system is recognized as occurring in two forms, the interstitial or exudative and the parenchymatous form. The two forms may occur in the same patient, but there are good reasons to believe one form does not change into the other form. Diagnosis of the exudative form should be made before gross lesions occur giving rise to various paralyses. The only chance the case of paresis has is in diagnosis of his condition in the neurasthenoid stage before the onset of well-known physical signs. The early diagnosis of tabes means the arrest of the disease when the spinal cord is not so damaged but that it can perform its function normally.

Neuralgia and neuritis should not be confused. Neuritis is shown by tenderness on pressure upon or by motion of the nerve trunks. Neuralgia presents no symptoms except pain. Difficult cases of neuritis are those showing only motor and trophic symptoms early in the case.

DISCUSSION

Dr. William G. Spiller: Dr. Gilpin has emphasized the importance of early diagnosis of nervous diseases. I think he has done well in making that statement, because on the early diagnosis must in large measure depend the treatment. The earlier the diagnosis is made the greater the danger of an incorrect diagnosis. Better to wait until the patient has symptoms to justify a diagnosis rather than to act on a badly formed diagnosis. Experience here comes into play, and one with more experience than another is more capable of making an early diagnosis under ordinary circumstances. We have heard this evening a great deal of the importance of making the diagnosis between functional disturbance and organic disease, but this is often very difficult to do. Often functional nervous disease is associated with organic nervous disease in the same patient, and it is difficult to say how much is one and how much is the other. I could give a number of illustrations. I speak only of one or two: A gentleman first noticed he had a weakness of one foot on going upstairs at his wife's funeral; the situation was such as to cause an hysterical attack. He died of brain tumor. A man was in a restaurant late at night; he and the proprietor were held up but not injured by men who forced their way into the restaurant. The next afternoon he was sitting at the front window of his house (he had had no symptoms of disease), when he saw the proprietor of the restaurant who had been with him the night before pass the window. He tried to get out of his chair and had great difficulty in doing so because of weakness. He died of myelitis secondary to perirectal abscess.

In tumor of the brain, as Dr. Gilpin emphasized, there is nothing more important than early diagnosis. One of the most satisfactory cases I have had was one in which a tumor of the brain hardly as large as the end of the thumb was diagnosed. Dr. Frazier removed it, and the patient has been entirely well for four or five years. The Bárány tests are particularly useful in the angle tumor; they have not been very useful to me in lesions elsewhere.

I cannot quite agree with the statement regarding the rarity of posterolateral sclerosis of the anemic type without changes in the blood. Pos-

sibly my experience has been unusual, but I have had many cases in which I diagnosed postero-lateral sclerosis of the anemic type without blood changes from the typical clinical findings.

In the present day the diagnosis of cord tumor has become very important, and the diagnostic helps we have gotten in the last few years have aided us considerably. The method of compressing the jugular veins, and seeing if the pressure rises in a manometer (Queckenstedt's sign) in lumbar puncture or in cisterna puncture, has been a great help. *X*-ray examination also has been useful. There have been some newer methods introduced recently—one of them the injection of lipiodol into the intradural space, by the method of Sicard. The results have not been altogether satisfactory. There have been serious reactions in one or two cases, with increase of cells in the spinal fluid and with pain and fever. Clovis Vincent is attempting the study of the epidural space, between the dura and vertebral column, with injections of lipiodol, and he finds this space permeable.

There is nothing more difficult than the diagnosis between encephalitis and tumor in certain cases. I have had patients sent to me as having tumor in which encephalitis existed, and I have refused to have operation done, and am thankful in some instances that I did not. Encephalitis may cause choked disk. The epidemic type varies so much in symptoms that we no longer care to use the term lethargic encephalitis. When syphilis is found by laboratory findings we are naturally inclined to believe that all symptoms are syphilitic, and often they are, and often it is wise to treat the patient as a syphilitic; but let us not forget that syphilis is not always wholly responsible and that a syphilitic patient is not immune to other ills and may have a brain tumor as well as anyone who is not syphilitic.

Dr. Gilpin has also emphasized in his paper the importance of the early diagnosis of tabes; the diagnosis of tabes in years gone by was a very dreadful one. Most cases we see in these days are of an abortive type, and if the diagnosis is made early and preventive measures inaugurated, as the avoidance of overdistention of the bladder when the sensitiveness of the bladder has diminished, or the straining of the optic nerve, much may be accomplished. The avoidance of excessive physical exertion may possibly prevent the development of grave incoördination.

I have never been sure what neuralgia is; to my mind it is the early stage of neuritis and is a condition which cannot be detected by the microscope. I cannot help but believe it is a form of neuritis in the earliest stage of that condition.

Dr. Gilpin did not speak of the diagnosis of early traumatic hemorrhage of the brain. I happen to be deeply interested in that condition

at the present time. A woman fell, in washing a window, in the back yard; no one was with her; she picked herself up; she was not unconscious. The next day she was able to attend to household duties, and for six weeks had severe headache and vertigo. At the end of that time she had an attack of severe vomiting and the next day she became worse. The following day, Sunday, and Monday she was profoundly stuporous. She had some weakness on the right side of her body and face, and I believed that with the history given she had a hemorrhage on her brain and that the clot ought to be removed. She was brought into the hospital; stereoscopic plates of the skull made by Dr. Pancoast were negative; the eye-grounds were examined by Dr. de Schweinitz and were negative; lumbar puncture was done by Dr. Grant and the pressure was only 6 mm. At 9.30 A.M. the day the woman entered the hospital her respirations were 15 and her pulse 56. Dr. Grant, with Dr. Fay, operated immediately, and hemorrhage was found on her brain and removed, and that woman is almost well. I am not prepared to say that in every case of severe traumatism of the head operation should be done, but I do say that when there is a distinct history of trauma of the head, and it is definitely known where that trauma was, and there are symptoms indicating a lesion at the place where the trauma was recently, which symptoms may persist even for weeks, and then an increase of symptoms develops from the lesion indicating an extension of the lesion, that is a case for prompt operation and many a life may be saved thereby that otherwise would be sacrificed.

MARCH 24

Vital Capacity: An Inquiry into its Value as a Diagnostic Procedure

BY JOHN H. ARNETT, M.D.

AND

K. KORNBLUM, M.D.

(*Abstract*)

From our own experience and from a study of the results of others we believe the vital capacity as now used incapable of clearly differentiating normal persons from those with early intra-

thoracic disease. In the more advanced cases the differentiation increases, but by this time definite physical signs are usually present. The procedure thus affords little aid in those cases in which the diagnosis is most difficult.

DISCUSSION ON THE PAPERS OF DRS. ARNETT AND KORNBLUM

Dr. George Morris Piersol: At a time when popular enthusiasm for measuring vital capacity has probably reached its height, it seems to me that a paper such as Dr. Arnett has just presented is an extremely useful and very timely one. There has been a tendency in recent years, a very praiseworthy one, to measure all vital functions, to adapt these measurements to clinical medicine. This has resulted in tremendous gain. It has had some disadvantage, namely, those who are not too clear in their minds as to their significance have had a tendency to utilize them as short cuts in diagnosis and to allow them to take the place of time-honored methods. There are some who have been induced by neat forms of apparatus to instal these machines as methods of arriving at a diagnosis and trying to arrive at a method of measuring one function to the exclusion of other things. The thing that strikes the ordinary clinician, that Dr. Arnett has emphasized, is something in which there is no unanimity of opinion. It is interesting to recall the fact that Hutchinson was the first to put this spirometry on a normal standard, and he examined over 2000 individuals in an effort to establish a normal. He had perhaps a more scientific mind than those who jump at conclusions without taking the trouble to find what the normal is. From that day to this every effort has been made to determine the normal, which is an essential thing. In discussing this paper with Dr. Arnett before the meeting, he remarked that without knowing the normal it would be just as intelligent to walk a man in the office and put him on the scale as it would be to take his vital capacity and not know more about it than is usually known. The variation from normal is great, and some individuals have vital capacity which is normal for that individual, but it is difficult and dangerous to draw deductions from any method when you realize that there are such enormous variations as just pointed out. There are certain advantages which this method has along with all other methods, provided they are checked up. You cannot take leukocyte counts, phthalein tests or even ordinary urine analyses and draw definite deductions without knowing something else about the patient. In determining vital capacity you must attempt to measure accurately physio-

logical function. If visualized in that light it is another help which in certain conditions probably furnishes very useful information. So far as I can make out the information obtained by ascertaining the vital capacity in pulmonary disease has been rather discouraging. In most of the pulmonary conditions the vital capacity can be recognized clinically just as well, although it is a good index to note how much the vital capacity has been impaired. It is probable that in cardiac disease it attains its greatest usefulness from the prognostic and diagnostic standpoint. The interference that this pulmonary congestion causes in the ventilating power of the lung can be recognized by taking the vital capacity. By doing this systematically in certain individuals it is held by many that you can gauge better without producing dyspnea and foretell cardial breaks before they actually occur. It has been held by some that it is a good check in precardiac cases with digitalin. When vital capacity is taken regularly and fails to show any impairment you can assume that the case has reached the point where it will not improve further and can gauge at that point how much exercise can be permitted.

Dr. Kornblum: Dr. Piersol mentioned the fact that investigators in their enthusiasm have attributed too much to the estimation of vital capacity. Recently an article appeared in which the authors used vital capacity in determining operative risk in surgical patients. Heretofore the vital capacity has been the exclusive property of the internist and medical man. The authors made the deduction that the greater the reduction of the vital capacity the greater the risk of any surgical procedure, and on this basis they made a comparison with the risk as estimated by the surgeon, and this was then checked against the actual outcome of the operations. It is hardly likely that the vital capacity will lend itself to such a method of application, and the authors themselves state that probably it is better to use the estimation of the surgeon in this respect. Now it is quite obvious in acutely ill surgical patients it would be extremely difficult to get sufficient coöperation upon the part of the patient as to render the vital capacity a reliable procedure. Imagine taking the vital capacity on a case of acute appendicitis or in perforation of a gastric ulcer, likewise any condition associated with pain on deep inspiration or expiration—this would practically exclude that individual's vital capacity being taken and a reduction of the vital capacity under such conditions would hardly indicate an intrathoracic lesion. It is hardly justifiable to compare vital capacity with the end-result of operation because there are many factors influencing end-result which have little or nothing to do with the patient's condition, for instance, the skill with which the anesthetic is administered or certain technical

difficulties encountered during operation or postoperative catastrophes. These are all factors which may cause the outcome to be fatal, even though the vital capacity as determined before operation may have been normal, so it is not likely that vital capacity will find very much favor or cause surgeons to add spirometers to their equipment.

Dr. J. Harold Austin: I would ask what value have these estimations of vital capacity, that is, what value may be attributed to them in repeated observations on the same patient?

Dr. Arnett (closing): To answer Dr. Austin's question regarding the value of repeated vital capacity estimations in the same individual: There are not many papers dealing upon this subject. Dr. Pratt has published a paper in which he has followed the vital capacity of certain patients over a number of years. In this paper he comes to the conclusion that there are even in normal individuals variations which cannot be accounted for. However, in comparison with the diminution of vital capacity which might be expected from tuberculosis, this is relatively small, and Dr. Kornblum and I rather have the feeling that it would be practical to have periodic vital capacity determinations made upon individuals in health (just as one has periodic determinations of weight made), that a drop in the vital capacity which could not be accounted for might be of considerable value from the diagnostic standpoint. An example of how the vital capacity may be used in this way, and may be of decided diagnostic value (and I think the only example to be found in literature), is in Hutchinson's article, which is far and away the best article on the respiration as a whole that I know anything of. Hutchinson, in his study of hundreds of cases, came across Freeman, the American giant and wrestler. His vital capacity was determined and duly recorded. Two or three years later Freeman found himself failing in health and consulted physicians, who examined his chest but failed to elicit signs of tuberculosis. His vital capacity, however, had diminished 31 per cent. On the basis of this Hutchinson suspected Freeman of having pulmonary tuberculosis, and told him so. Later on the American giant went from bad to worse and died of pulmonary tuberculosis. So if it is possible to follow the vital capacity of patients from year to year, making due allowance for the increase in vital capacity from childhood to manhood, and the drop in vital capacity due to advancing years, making allowance for any diminution of vital capacity due to obesity, change in occupation or intercurrent infections which might leave their mark on that individual's lungs, vital capacity would be of considerably more diagnostic value than at present, to say the least, and

it might be a method of considerable value in the diagnosis of intrathoracic disease. As Dr. Piersol says, following a cardiac case from day to day the vital capacity has been found of definite value in giving evidence of improvement or decline. Workers with tuberculous patients also have found that the vital capacity to a certain extent does follow the clinical condition of these patients, and so our conclusion of the whole matter was that if the vital capacity were used in this latter way in following cases known to have disease, or if we follow our patients from childhood through their lives and keep a careful record of their vital capacity, making whatever allowances should be made, that under these conditions vital capacity would be of value to the clinician.

Neurocirculatory Asthenia

BY HARLOW BROOKS, M.D.
NEW YORK CITY

Before the war but very little recognition was given, by the average practitioner at least, to the subject of neurocirculatory asthenia. All of us were meeting with these cases, and for the greater part we were classing them as neurasthenics, as hyperthyroids or as hysterical persons. It was only when large groups were gathered together, and when we were able, as it were, to view the condition in bulk, that we were brought to a realization of the importance of the condition and to adequately estimate its very frequent occurrence. Even now many text-books entirely ignore the subject or describe it in such a brief and inadequate fashion that the student can have no proper appreciation of its importance until he is brought into actual contact with the cases in his hospital or private practice.

Although the name of neurocirculatory asthenia is by no means generally accepted, it probably is that term which most satisfactorily describes the condition. The complex has been perfectly recognized for a great many years, and one of the best descriptions is by a famous Philadelphian, I. M. Da Costa, then an acting assistant surgeon, I believe, in the Union Army. The

medical volumes of the Surgeon-General's *History of the War of the Rebellion* frequently refer to the condition, and while the comment is made that it has been largely brought to the fore by conditions of military life, it is, in the main, recognized that the syndrome is but a tendency or condition very frequent in civil life which is, perhaps, brought to the surface under military conditions.

Perhaps the complex is best known in civil life under the title of irritable heart, and this was the name suggested by Da Costa, who, with Weir Mitchell, referred to it as "irritable heart of the soldier."

Everyone of us, no matter what specialty we practise, meets with these cases, and this is the reason that I bring it before you for discussion tonight. It is no more to be grouped as a military disease or condition than red hair or hernia or pex planus, myopia or chronic otitis media, all of which conditions become dominantly apparent under a universal mobilization of any sort.

Hartshorne, I believe, also contributed a notable article on this subject before this very society during the Civil War.

The British seem to prefer the term of effort syndrome, since they found it chiefly apparent in their young soldiers who had been abruptly plunged with very little physical preparation into the stress of modern warfare. We found it more frequent in our recruits who had never seen anything approaching actual war conditions, aside from the tremendous emotional tempest which always sweeps over a country during such public calamities. The explanation of the British standpoint as compared to ours, for you will find a most striking and essential divergence in the descriptions of the two conditions, lies essentially in this fact. The British recruit of this tendency broke because he had been submitted to war stress without a careful elimination of such men by an examination, or least not one so critical as that to which we submitted our men. Our cases for the greater part were eliminated from the combatant forces before they reached France. I did see, in France, in our own men, many cases of effort syndrome precisely such as the British describe, but only

because a certain percentage of these defectives had escaped elimination through insufficient examination, and were sent with combatant units. These of our cases were precisely like those of the British, French and Italians. This explanation will, I think, suffice to make clear the very wide divergence between our descriptions of the complex and, notably those of the British.

The syndrome has always become dominant in conditions of great emotional disturbance during revivals, business depressions, war and the like. It exists at all times, but those who suffer from it most strikingly manifest the evidences of the condition under emotional stress, for the syndrome, as a whole, is definitely allied to emotional instability.

The physical appearance of these cases is quite characteristic. In most cases it is almost conclusively diagnostic. As to the figure, there are two types. In the one the patient is tall and slender, likely to be slightly stooped in posture. The thorax is narrow, long and rounded in form. The extremities are long, slender and more of the female type in general configuration. Muscle development rarely becomes prominent. The hands and feet are usually long and slender, and they are practically always cyanosed, cold and sweating. The capillary return in them is almost always delayed and a postural cyanosis is present.

The other type, which is by far the less frequent, is of a coarse build. The trunk is flat, almost to the point of thinness; the chest is broad and fixed and little respiratory alternation takes place. The figure is squat and the skin coarse.

As a rule, the skin of the first and predominant type is very smooth and soft. The deposit of adipose is rarely large, though occasionally one sees cases of the squat type who become quite fat. Dermographia is very marked and alternate flushing and paling of the skin is strikingly manifest, especially under emotional stresses. The hair is thin, soft and likely to be curly. The distribution in males is more like that normal to the female, and in the female more like that in the typical male. The beard is sparse and often entirely wanting.

The external genitals are usually small, frequently defective in

some way and the testes are often undescended. The occurrence of inguinal hernia is common. The scrotum is small, rarely pendulous. In the females the pelvis is often poorly developed and it reverts to the neutral form. The breasts are almost always poorly developed and in pregnancy they are usually unable to maintain lactation in any sufficient degree. Hypoplasia and malformation of the uterus and ovaries are common.

The thyroid gland is nearly always prominent and the neck notably long and thin. The facial expression is mobile, sensitive and the eyes usually prominent, though not necessarily exophthalmic. The lining of the face is rarely deep or the expression sinister.

Age. The condition is chiefly apparent during the most emotional ages. It is a disease of early puberty. It is seen rarely and only in a much modified and reduced type in old age. During adult life it is much less frequent than in the teens and early twenties. We may represent its occurrence as to age, with a rapid crescendo beginning with the early manifestations of puberty and a prolonged diminuendo as age approaches.

Sex. As to the occurrence rate determined by sex I am somewhat in doubt. My observations during the war, the only time when I had ample opportunity to carefully study the condition in its daily manifestations, has, of course, strongly influenced my impressions as to its chief occurrence being among young men; but it is also a very common condition among young women, perhaps equally so. Since its symptoms largely evidence traits considered more or less as normal to women and as definitely unfitting or abnormal in men, it is quite probable that we are more struck with its appearance in men as compared to women.

Heredity. Hereditary influences are definitely traceable in most instances. One or both parents usually show traits of nervous or endocrine instability of one sort or another. They may be hysterical, hyperthyroids, neurasthenics, hypersensitives or insane, or they may, like their offspring, show the manifestations of this complex itself. There is almost always a definitely obvious hereditary influence of instability of some sort present either of the nervous, endocrine or circulatory systems.

Race. The condition shows also a very definite racial or national influence. Statistics collected by Dr. Goddard, at Camp Upton, showed that of these cases among the men of the 77th Division, by far the most frequent appeared among the Hebrews, notably among the Russian Hebrews. Next in occurrence came the Italians, then the Irish, the American, the British, Scotch, German, and last of all in point of frequency of occurrence was the negro. From an entire brigade of negro troops mobilized largely from this territory, though augmented by several contingents from the Southwest, but one case of clearly defined neurocirculatory asthenia presented itself at the Base Hospital during my service there. The complex then seems to bear a very definite relationship to the emotional status of the various races of peoples. Probably for this same reason, as well as from, in part, environmental influences, the condition is apparently much more commonly seen in urban than in rural communities.

The statement has always been made that the condition is not frequent in old age. There are several explanations for this fact. No doubt the first and most important one is that the normal changes of age are such as to diminish or profoundly modify the typical manifestations of the syndrome. There is a further definite factor playing a large role here. As a class these patients are short rather than long-lived. The British in particular have showed that these people are particularly susceptible to the infections, and that they succumb to them in a considerable higher percentage than entirely normal persons. They also endure the buffets and stresses of life much less well; they wear themselves out, as it were, by their overemotional expenditure. They withstand such conditions as diabetes, nephritis and particularly the cardiac disorders in a definitely subnormal way.

We may quite satisfactorily group our signs and symptoms shown in this syndrome under the heads of circulatory, nervous and mental, endocrine, respiratory, digestive and muscular.

Circulatory. Although apparently entirely secondary in nature, and certainly not definitely etiologic in character, the circulatory manifestations are clinically the most important and

striking in many cases, and they dominate the average case. As a rule, marked tachycardia is present. Tests show, however, that the cardiac rate is chiefly influenced by emotional rather than by physical conditions. Very often slight exercise, well within the physical possibilities of the patient, such, for example, as the usual tests for cardiac muscle reserve, will cause a slowing of the rate even down to the normal, while emotional stimulation will almost, without exception, augment it. Irregularities are often present, but analysis shows them to be chiefly of sinus origin in uncomplicated youthful cases. True paroxysmal tachycardia eventually develops in a good many instances, particularly in those of long duration. Cardiac murmurs are almost always present. They do not usually follow established routes of transmission, nor do they occur constantly. They are most commonly found at the base of the heart and, as a rule, they disappear or decrease in intensity on moderate exercise. Notwithstanding all this, the cardiac reserve is lowered in almost all instances, and very few of these patients have a normal cardiac muscle reserve, especially for long-continued though perhaps moderate demands, and cardiac exhaustion occurs much earlier than in normal persons. The blood-pressure is ordinarily low, except when complications have taken place. In certain cases quite a marked pseudo "pistol shot" may be audible over the larger peripheral trunks, and in some cases the diagnosis of a true aortic endocarditis may be apparently justified. Needless to say, prognosis is very different in the two conditions.

Many cases show also marked throbbing of the peripheral vessels, such as appears in true cardiac palpitation or in Graves' disease. Slowing of the capillary return, particularly in the skin of the extremities, is usually seen. The hands may be blue and as deeply cyanosed and as cold as in advanced cardiac decompensation. This phenomenon, which is often transitory, is usually accompanied by a cold sweat, especially profuse over the hands, feet and the skin of the axillæ. Marked flushing and paling of the skin, especially that of the face, is ordinarily present. It is developed mostly by emotional stimuli. Dermographia of

all sorts is very striking. All these manifestations are exaggerated by emotional stress; most of them are diminished by mild physical exercise.

As a rule the heart is found on fluoroscopic or *x*-ray examination to be small rather than large; often it is of the drop type, long and narrow. Rarely only, in spite of the overaction usually manifest, is a hypertrophy of the left ventricle present. Under too great physical demand, or even from merely overemotional stress, acute dilatation occasionally appears in apparently previously normal hearts. These cases cannot respond to a cardiac demand of a degree normal to the average healthy person. This is especially shown during the acute infections where acute dilatation often appears without apparently adequate cause. Hypoplasia of the aorta and other major trunks is the rule. These patients are also usually very sensitive to the vasodilators. They do not, as a class, react satisfactorily to the digitalis group of drugs.

Nervous and Mental. Of little less characteristic nature are the nervous and mental evidences of this dyscrasia. The patients are almost without exception neurotics and overemotional, though occasionally repressed. As a rule, they are voluble and over-expressive of their discomfort and complaints. They weep easily, profusely and frequently, like the type of women described so eloquently by the elder Mr. Weller. Their responses to nervous and mental stimuli are almost invariably overreactions or exaggerations. It is important to mention here that some of these cases occasionally manifest attacks of syncope, closely simulating those occurring in petit mal. Most of them eventually get well, as the general condition improves, or if the reverse follows these attacks take on more certainly evidences of hysteria. Often these syncopal or "fainting" attacks disappear under favorable emotional and sexual adjustments.

The knee-jerks are greatly exaggerated, so are all the other normal nerve reactions. A pseudo-ankle clonus may be present. Sleep is usually fitful and inadequate. Sleeplessness is in fact one of the most serious symptoms of the condition which the

physician is called upon to treat. One must not, however, get the idea that all the nervous reactions are abnormal in their nature. Among many subjects of this disease the creations of genius are evolved by those oversensitive reactions. Musicians, actors, writers and painters are frequently of this type. In nearly all the arts and in some of the sciences these overemotional responses bear rich fruit in works of real genius, acts of heroism and in the highest evidences of intelligence. Let us not forget this fact, though we also admit a relationship to hysteria, shell shock and other allied disorders.

This is also well illustrated in the selection of occupation by persons of this type. Almost without notable exception successful men suffering from this complex are found in the ranks of mental in contradistinction to physical occupations. Those subjects of this syndrome who elect laborious vocations are for the greater part failures, while a large number become notable successes in those channels of work which require emotional and mental effort. This same tendency is shown in the selection of sports and games. Subjects of this syndome rarely select outdoor recreation, but prefer those diversions better calculated to their capabilities, such as cards, chess, dancing and the like.

Endocrine. It is extremely difficult, even impossible, to separate the signs of endocrine disturbance from the nervous and mental symptoms of the complex. Probably there is no true separation. In by far the larger number of cases definite thyroid hypertrophy is manifest and such indications of hyperthyroidism as sweating, tremor of the hands and tongue and dermographia are strikingly manifest. A very large number of cases show the so-called Goetsch reaction, and there is considerable evidence that the tachycardia present is at least in part an evidence of hyperthyroidism. I have myself described the condition as being a hyperthyroidism, though I now feel that although hyperthyroid activity is a part of the condition it is not invariably so, nor is this the sole explanation of the syndrome.

There is no doubt whatever but that a great many cases of neurocirculatory asthenia are considered by many practitioners as

simple instances of hyperthyroidism, particularly as of the "forme fruste" type. It is a misfortune, however, when these cases are treated on this sole assumption, as not a few of them are.

Hyperthyroidism is further simulated when an exophthalmos develops under emotional excitement. This is present in many cases in varying degree. In all probability this sign of the complex admits of the same explanation as that concerned in Graves' disease. It varies greatly from day to day, just as it does in true exophthalmic goiter, but it is not a hallmark of the disease.

Certain symptoms present in some cases suggest that adrenal defects may be present in the condition. This is notably suggested by the almost universal early exhaustion which is shown. The usual low blood-pressure also suggests adrenal defect, but when renal complications appear this may be altered into a hypertension. My personal belief is that the adrenal plays no important role in the complex. I believe also that there is little or no evidence tending to indicate primary disturbances of the pituitary.

In so far as I have been able to find, and I consider myself rather familiar with the literature on this subject, there are no accurate studies which connect disturbances or lesions of the thymus body with this disease. In very many developmental and clinical aspects, however, these cases very strongly suggest a close relationship to the status lymphaticus. If one accepts the exceedingly clever and strongly buttressed theories of Warthin as to the nature of Basedow's disease, which definitely places this condition as a thymus disturbance, one is almost forced to assume that neurocirculatory asthenia belongs also to the same classification. Pathological studies, which are so very largely wanting in this disease under our consideration this evening can only decide this point. I confess that I believe that this syndrome stands between Basedow's and status lymphaticus from a general standpoint.

As regards disturbances of the sexual glands, a very certain dependency also exists. Very many instances of sexual inversion and perversion are seen among these patients. More than seldom normal sexual sense is almost entirely wanting or little

differentiation of psychic sexual sense has taken place. Goddard's analysis showed that a very high percentage of young males, suffering from the complex in our division, had no real sexual experience or normal sexual desires. Both in males and females there is a very distinct evidence at least of sex immaturity. The secondary sexual anatomical characteristics are seldom normally developed. These cases show a very low fertility rate. To my mind one of the most significant and far-reaching of the evidences of this disease is found in these definitely defective and abnormal sexual characteristics.

Perhaps also the endocrine disturbances evident in this interesting condition bear on the selection of occupation. Few of these patients are found among general laborers. They are, almost without exception temperamentally and physically unfitted for such heavy work. They are rarely farmers, seamen, miners or the like; neither are they adventurers, huntsmen or trappers. Almost without exception they are indoor workers, clerks or professional men. Many are artists, teachers, musicians, writers and the like. Some of our most productive and useful citizens are definite sufferers from this complex. It is, in my opinion, often a large factor in the artist's "temperament," of the zealot's conviction, and it may be the impelling agent of the drug fiend's downfall. A very large number of sufferers from this complex are found among the criminal classes, especially among drug habitues, sexual perverts, pickpockets and petty thieves. Few of the major crimes are personally planned or performed by this type of men.

Respiratory. Among the respiratory signs and symptoms the chief of the signs is the usually long, narrow chest or flat thorax, a general phthisical type; rapid respiration is the most frequent symptom. When asleep, as a rule, the respiratory rate appears to fall to the normal, which would seem to indicate, as I believe to be the fact, that the chief fault here is largely emotional rather than due to any real respiratory lesion. These subjects are definitely sensitized toward tuberculosis and all other manner of pulmonary infections.

Digestive. Among the signs and symptoms of the digestive tract one must especially note the frequency of enteroptotic viscera, of hyperacidity, of gastric and intestinal flatulence and of poor metabolism in general. Two types of the condition are definitely apparent as regards nourishment: Those who are very thin, malnourished, and those who are overfat. Constipation, frequently alternating with diarrhea, is common. Mental status greatly influences all the gastrointestinal signs and symptoms.

Muscular. As is the case with the heart muscle, so also with those of the skeletal system, poor muscle tone is the rule. Though many of these patients may show considerable muscle adroitness, few, indeed, have a normal muscle reserve or endurance. Early exhaustion of the skeletal muscle was one of the symptoms particularly commented upon by the Civil War observers, and by military and medical authorities alike. It is real, not merely psychic, but it is strongly influenced by emotional and endocrine status.

There are, of course, many other symptoms and signs which occur in this complex, but it is not my purpose to complicate this rather complicated clinical picture unnecessarily, and I shall omit their delineation, hoping, however, that you will bring many of these points out in the discussion which I trust will follow this paper.

In the treatment of this condition it seems to me that we have a double role to play, one social and the other medical. Many of the cases which come to us are still young, and while the type of the general condition is very evident, once your attention has been attracted to it, it may not be far advanced. Very much can be done with these early cases. One must not try to make a silk purse out of a sow's ear, to use a homely old phrase. I would rather paraphrase it here, however, and say that one should not attempt to make a sow's ear out of a silk purse, for it seems to me that, recognized and properly directed, most of these patients may be guided into channels in which they may become most useful and productive citizens, but never if they are allowed to elect occupations and trainings for which they can never

adequately fit themselves. The election of an occupation should then take full cognizance of the fact that these individuals can never rise to a truly normal physical standard. Their activities must be chiefly directed along these lines of endeavor in which adroitness replaces physical stamina, and in which their over-emotional output is capitalized and utilized instead of becoming a culture medium for neurasthenic and hysterical imaginings.

In some instances these factors have been taken cognizance of in the selection of the type of vocational training adapted to certain cases of shell shock. In other instances, especially in the early days of this work, all these factors have been ignored, and we have succeeded in untraining good carpenters to make pseudo-stenographers, and *vice versa*.

It is my belief that careful and well-supervised physical training will do very much to overcome these tendencies. I am much in favor of encouraging dancing, such games of skill as golf, supervised calisthenics and other forms of physical training. Nothing, however, which implies abnormal heart strain or overmuscular exhaustion should be permitted. There can be no question but that the class training most happily worked out by the British in the rehabilitation of these cases, even after man-grown, did very much toward bringing them back to a relatively normal standard. It is very pleasing to note in this regard that this method was lifted bodily from the teachings of Da Costa, Hartshorne and others of that school. If this is possible, as has been shown to be the case, with young adults, then it is quite certain that if these methods are established in the early teens that we shall prevent many cases developing. I have seen some particularly brilliant results, especially as regards the elevation of cardiac and skeletal muscle reserve, follow supervised training and education in mild outdoor sports and the like. Overphysical stress must never be permitted. Some successful college athletes who break in early after life are doubtless of this type.

I do not feel myself competent to adequately discuss the mental and emotional training which these individuals should receive. I know that wise teachers and parents and that experienced neu-

rologists and psychiatrists do a great deal with these patients. Certain it is that self-control, emotional curbing and cultivation of normal reactions to normal environments should be encouraged. Results of a most beneficial nature may be achieved along these lines, and age is often an adjuvant of great value.

I know from experience that the physician can do a great deal along established and well-accredited lines of treatment—the correction of anemia by diet with iron and arsenic, sunlight and open air, the correction of constipation by diet, exercise, and if need be by the added use of proper drugs. The mere confidence inspired in the emotional and receptive patient by the supervision of a respected practitioner has in itself much of therapeutic good in so far as instilling self-confidence and poise into these patients is concerned. When it is possible, the patient's studies and work and notably his recreations should receive the attention of the physician. Diversion selection is perhaps of secondary importance, only to the selection of an occupation for the patient suffering from this complex.

I believe that the symptomatic use of drugs is very beneficial. When a tendency to heart dilatation is shown, rest and digitalis act beneficially, especially the rest, for digitalis often fails in these cases as it does in instances of hyperthyroidism. The bromides sometimes combined with cannabis indica are very helpful in many cases. Of course, one will avoid, as far as possible, the use of the opiates and of the other habit-forming drugs, particularly because of a definite tendency on the part of these patients to take on drug habituation, especially heroin addiction.

In my experience an attempt to reduce muscle exhaustion by the use of strychnin, caffein and similar preparations is unwise and inadvised, much as one may be tempted to try them out because of their symptomatic indication. Carefully adjusted physical training is far more certain of result.

Here would seem to be a condition in which the use of the endocrines might work marvels. Perhaps they sometimes do. Theoretically the use of the sexual gland specific to either sex would seem to be a direct indication. My experience is as yet

too short to permit me to say more than that I believe that good results along these lines are being reached. I find it very hard, however, to convince myself entirely of the certainty of results achieved along this line in a diseased condition in which the confidence and hope of a trusting patient with an abnormally exaggerated emotional status may lead, he may well deceive the physician as well as himself. Thyroid has been recommended by some, particularly in the fat cases. I feel that I have done more harm by the use of thyroid than I have achieved benefit—perhaps you see that I have not entirely divested my mind of the feeling that a hyperthyroidism has something to do with the production of the condition. Be that as it may, I advise against experimentation with thyroid, and my use of drugs and endocrines has been determined by individualistic and symptomatic indications for the greater part. My great reliance is placed on the elevation of muscle reserve by diet, rest and carefully supervised training. The emotional aspects of the condition have been most improved under my observation by intelligent attempts at mental and emotional control, not repression and by education and adjustment of emotional output along normal channels.

DISCUSSION

Dr. James E. Talley: I have listened with much pleasure to Dr. Brooks's paper. He has brought out the fact that not only did Dr. J. M. Da Costa fully describe the irritable heart, but that he also made use of exercise in the form of marches for trying and sorting out these patients for return to duty. Lewis elaborated this idea at Colchester with excellent results, as did Heard with our own men later at Angers. As Dr. Brooks has pointed out, these patients exist in civil practice, many of them with an underlying cause of strain, physical or mental or both. Modern cardiac diagnosis has been greatly developed by the opportunities afforded for studying large groups of troops suffering from actual or supposed heart disease. The cardiovascular examiners were confronted with a paradoxical situation, on the one hand, the effort syndrome cases with all the symptoms of cardiac disease, but which on careful study were shown to be probably not of cardiac origin, but to be the cardiac phase of neuroses, as Cohn puts it; on the other hand, there

was a group with actual cardiac disease free from symptomatology because the myocardium was good. This paradox led the examiners to seek an explanation, resulting in greater precision of diagnosis. Prior to this we heard little of using posture and exercise to bring out the murmur of mitral stenosis. Another outgrowth was definite criteria for the diagnosis of mitral insufficiency. These criteria are definite enlargement of the heart, a history of acute rheumatic fever within ten years and an apical systolic murmur. The presence of the latter with either of the former puts us on surer ground, as Rothschild has shown by a study of a large series of cases. Again, it has been demonstrated that the murmur of aortic incompetence may be detected with the naked ear and the auscultating towel, with the patient bent forward at an angle of 45 degrees, where the stethoscope fails, and that the Bowles is better than the ordinary stethoscope for detecting this murmur.

Dr. George Wilson: I have been in the Veterans' Bureau for two or three years and I have had under my care a great number of men with effort syndrome and can subscribe to what Dr. Brooks said of physical condition. It seemed to me that he struck the key to the situation when he enumerated both mental and physical defects. A great many of them are inferior types. I do not believe that the thyroid gland has much to do with this condition, excepting, perhaps, as the thyroid is inherently an organ to regulate the rest of the body. Lewis and the British have placed a great deal of stress on the presence of infection. We have had our men thoroughly combed for infection and have had such eliminated and the condition has gone on without change. Probably one of the commonest complications has been a rather low-grade pulmonary tuberculosis. In regard to the thymus we have had the thymus x-rayed and it was enlarged in none. As far as therapy is concerned, undoubtedly the exercises are the best for treatment. I would give in effort syndrome large doses of strychnine, much in the same way as we give it in trigeminal neuralgia. This might be called a neuralgia of the vagus.

Dr. Charles C. Wolferth: I should like to mention one point which may help to explain the opposing views of Dr. Brooks and some of the British writers on this subject. After the Armistice I was attached to the Military Heart Hospital at Colchester. The cases as seen there have been faithfully and graphically described in Sir Thomas Lewis's book. There were received among the cases at that time many men who had served in Mesopotamia and through the East. Among these

cases were not only the purely constitutionally inferior, but a much larger group in which unaccustomed climate, hardship and infections, such as malaria and dysentery, had been of importance etiologically. Many of these cases did not develop the effort syndrome until after two or three years of service. In this latter group the prognosis was quite different than in the constitutionally inferior, and improvement often coincided with graded exercises as well as good food and quiet, ordered, comfortable life and surroundings. In the purely constitutional cases graded exercises were of value in classifying the cases according to severity, but there was not very striking evidence of therapeutic benefit.

Dr. Robert G. Torrey: I have had an opportunity to study a large number of cases of irritable heart following gas inhalation, particularly phosgene gas, also many cases following influenza pneumonia. This condition seems more constant in its occurrence after phosgene poisoning than after mustard gas as chlorine bronchitis and more frequent after influenza pneumonia than after lobar pneumonia.

Severe cases of effort syndrome or irritable heart occurring in previously normal individuals apparently cleared up satisfactorily under systematic increasing exercise.

I believe that the cases which Dr. Wilson sees now at the Veterans' Bureau are of the same type which Dr. Brooks describes so admirably. They do not recover from this condition because they are constitutional defectives of various types, including thymicolymphatics, of whom many certainly are observed among these persistent cases.

The striking abnormal condition present is a severe degree of anoxemia in influenza pneumonia and in phosgene poisoning. These are the diseases which are regularly followed by irritable heart.

It seems to me there is reason to believe that the explanation of these cases lies in a respiratory center disturbance, probably due to damage wrought by prolonged anoxemia.

After phosgene poisoning the respiratory center seems to act in a manner analogous to the action of the exhausted heat regulating mechanism in sunstroke. These individuals breathe normally when perfectly quiet or during sleep. A slight amount of exertion throws the respiratory mechanism entirely out of gear. The disturbances due to hyperventilation resulting from the rapid respiration in these cases need more study.

The only benefit I have seen in these cases apparently resulted from increasing exercise.

APRIL 28

Xanthochromia of the Spinal Fluid in Cerebrospinal Meningitis*

BY JOSEPH E. HIRSH, M.D.
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In 1903 Froin,[1] a French neurologist, published a paper in which he called attention to certain changes which occasionally occurred in the spinal fluid. These changes consisted of a golden-yellow color, an excess of albumin, with spontaneous coagulation and an exceedingly high cell count.

Froin reported 3 cases: The first was that of a woman, aged thirty-six years, with right facial palsy, followed four months later by painful, flaccid paraplegia. The spinal fluid was yellowish, coagulated into a compact clot a few minutes after withdrawal and the globulin was greatly increased. The second case was that of a woman, aged twenty-three years, suffering from tuberculous osteitis, who developed symptoms of meningitis, from which she subsequently recovered. On the twenty-eight day fluid was withdrawn from the spinal canal, which coagulated at the end of an hour. The globulin and serum were greatly increased, and smears showed a few Gram-positive diplococci. The third case was that of a man, aged forty-eight years, with paraplegia of a week's duration, following a so-called "cold." The spinal fluid was yellowish and coagulated within half an hour. Lymphocytosis was present and the globulin of only average amount. Spontaneous fibrinous coagulation in spinal fluid is very rare. Froin was only able to find 2 cases at the time of his report. Since Froin's publication a number of contributions have been made to this subject. Nonne[2] reported 3 cases in 1908; Raven,[3] a pupil of his, collected 47 cases in 1912; Mestrezat,[4] 21 cases the same year; Elsberg and Rockfort[5] increased this number

* From the medical wards of the Philadelphia General Hospital.

to 92 in 1917; finally, Sprunt and Walker[6] gathered altogether 100 cases about the same time.

The cause of this type of fluid, as established, is obstruction somewhere in the subarachnoid space. In 70 per cent of the cases reported by Sprunt and Walker this obstruction was due to a tumor of the spinal cord or vertebræ. Some of the other conditions found were tuberculous spondylitis, intradural tuberculous granuloma, extensive adhesions between the cord, arachnoid and dura in meningomyelitis, and gumma of the meninges.

Only 3 cases were found in the literature which ascribed meningitis as the cause of the Nonne-Froin syndrome, as it is now known. One of these was a case of cerebrospinal meningitis, consequent on an intraspinal injection of stovain and reported by Froin and Foy;[7] another, a case by Boyd;[8] a third, a case of tuberculous meningitis in an infant, reported by Leitch.[9]

Our own case is as follows: G. S., a white man, aged thirty-seven years, employed as a night-worker in a storage-battery plant, was admitted to the medical ward of the Philadelphia General Hospital at 10 A.M. on January 30, 1924. He was highly delirious on admission, and soon after became semicomatose. According to his wife, he had been in excellent health when he left for work at 5 o'clock the previous evening. About midnight he was suddenly seized with an excruciating pain across the small of his back, followed almost immediately by an intense frontal headache and a stabbing abdominal pain. He was taken home at once, and soon after reaching there he began to vomit a large amount of green watery fluid. At 2 A.M. he had a severe chill, and two hours later he became delirious, in which state he remained up to the time of admission.

The past medical, family and social history were all negative. The patient was an exceptionally large, well-developed, robust man, aged thirty-seven years.

Physical examination revealed little except a slightly increased patellar reflex, bilaterally and a suggestive Brudzinski.

On lumbar puncture, the fluid was slightly increased in pressure and distinctly milky in appearance. Upon examination it was

found to have a heavy trace of globulin, 12,000 cells per 1 c.mm., of which 95 per cent were polymorphonuclears, and a Gram-negative intracellular diplococcus. No red blood cells were present. The routine blood study showed a normal red blood cell count and hemoglobin percentage, with 18,400 white blood cells, of which 86 per cent were polymorphonuclears. Urine analysis, blood chemistry, blood Wassermann, spinal fluid Wassermann and colloidal-gold curve were all negative. Thirty cubic centimeters of antimeningococcic serum were given intraspinally, after removing an equal quantity of spinal fluid. This was repeated twice the following day, after which the patient seemed greatly improved. Two days after admission he exhibited rigidity of the neck, slight opisthotonos, a bilateral Kernig and a marked bilateral Brudzinski sign. Cisterna puncture was then done, the spinal needle being introduced into the cisterna magna at the base of the brain, and 20 cc of the serum given. In addition, large doses of the serum were given intramuscularly, as well as the continuance of daily lumbar punctures and injections. The patient, however, continued to grow worse. On February 4, herpes labialis appeared. On this day the lumbar puncture, to our great surprise, yielded golden-yellow fluid, resembling picric acid solution. It was under diminished pressure, quite viscid and had some flocculi in it. A cisterna puncture performed the same day produced, however, the same character of milky fluid that had been obtained on all previous occasions. There was a little over 0.1 (0.183) per cent of albumin in the cisterna fluid, while that in the lumbar fluid amounted to 1.6 per cent. Both fluids gave a very faintly positive test for blood, by both the benzidene and spectroscopic methods, but the difference in the two was not sufficient to account for the great difference in the appearance and viscosity of the two fluids. This strange contrast of the two fluids from the two different localities was noted each day, until February 8, when the patient, who had shown some signs of improvement for thirty-six hours previously, suddenly lapsed into coma, and died fifteen minutes later. The meningococcus was isolated by culture from the last spinal fluid removed before death.

The patient received a total of 1020 cc of antimeningococcic serum as follows: Intracisternally, 75 cc; intraspinally by the lumbar route, 225 cc; intravenously, 75 cc; intramuscularly, 650 cc.

Autopsy. Nothing of note was found in the visceral organs. The brain and cord were examined by Drs. N. W. Winkelman and R. B. Richardson.

Grossly, the following points were noted in the brain: (1) The vessels were very small and showed definite sclerosis; (2) the pia-arachnoid covering the cerebral surfaces showed a translucency, the brain, an edema; (3) over the pons and medulla the pia covering was slightly milky, while over the cisterna the membranes were somewhat dusky. The *cord* showed a markedly thickened dura, which cut like leather, and on opening the dura it was found to be adherent to the pia-arachnoid. On peeling it off granular surfaces remained. The undersurface of the dura was covered by a thickened brownish membrane. The dorsal region was much more involved than the cervical and lumbar regions, as these last two areas were reached by the serum.

The cord itself was obscured by a greatly thickened, yellowish-white exudate, more marked on the posterior than on the anterior surface. At one point in the upper lumbar region there was a distinct hemorrhagic extravasation, 2 cm. long and ½ cm. wide, which was about 5 cm. above the site of the lumbar punctures.

Microscopically, the cortex showed edema and marked infiltration of the polynuclear cells, the infiltrating mass of cells forming a depression in the cortex, in several places, but no actual penetration. Similar changes were in the cerebellum. In the thoracic region of the spinal cord there was a massive cell accumulation, in the subarachnoid space, mainly of the polynuclear type, held within a fibrinous meshwork, so as to cause a complete blockage in this region. Thus it is seen that with the extravasation lower down there were two definite areas of obstruction of the spinal cord.

There are two distinct features to be noted in cases presenting xanthochromia. One is the yellow color. The other is the presence of an excessive amount of protein. In some instances

there is a third feature, namely, a high cell count, but this is not constant. The high protein content is responsible for another feature occasionally present, *i. e.*, spontaneous coagulation. Nonne and Raven divide the cases into two groups: (1) Those with a high proteid content (phase 1); (2) those with a high cell count (phase 2). These features are found most frequently in cases of cord tumor, dividing the canal into two compartments, and are found only in the lower compartment. The 3 cases of cord tumor reported by Nonne, in 1908, all had an excess of proteid, with no pleocytosis, and this he regarded as an early manifestation of the Froin syndrome. Raven reported 47 cases of cord tumor in which the proteid content was high, with a low cell count.

How many of these cases showed xanthocromia and massive coagulation is not stated.

In 1912 Mestrezat reported 21 cases which exhibited the early stages of the Nonne-Froin syndrome. These he grouped under the heading of "Les Cas Frustes," or imperfectly developed examples of xanthochromia, and subdivided them into three classes: (1) Those showing absence of xanthochromia; (2) those showing absence of pleocytosis; (3) those showing a variation in the formation of coagulum.

Mix[10] has pointed out that any pathologic alteration of the vertebræ, dura mater or pia-arachnoid which leads to partial or complete obliteration of the pia-arachnoid space, with the formation of a cul-de-sac, is capable of producing xanthochromia. Pleocytosis, however, will be absent unless there is inflammation. Again, Mix divides the cases into three groups as regards their etiology: (1) A meningitis which has caused adhesions between the meninges and the surface of the cord; (2) pachymeningomyelitis of the conus terminalis; (3) a tumor which compresses intradurally or extradurally.

It is in this last group that most of the 92 cases collected by Elsberg and Rockfort occur. Of this number only 7 showed spontaneous coagulation and but 12 exhibited xanthochromia. Of the 24 cases of extramedullary tumor 10 (41 per cent) had

yellow fluid. It was not present in any of the 12 cases of intramedullary growth or in any with extradural growth. In all but 1 of the cases with xanthochromia the block was in the lower dorsal or lumbar region. According to these investigators, pressure of the fluid varies, so that no emphasis is laid on this point, nor upon the presence of substances which reduce Fehling's solution, as this test was positive in 91 of the 92 cases. They further note that the presence of Froin's syndrome, *i. e.*, yellowness, with an increased number of lymphocytes, and rapid coagulation, is characteristic only of large tumors of the conus and cauda equina, as sarcoma and endothelioma, whereas the syndrome of Nonne—globulin, without cell increase—is more often found in tumors at other levels. A combination of the two, while not as common as Nonne's syndrome, is more characteristic of extramedullary compression, by tumor, and is quite rare in any but extramedullary tumors. The 92 cases comprised eighteen different conditions, but not 1 case of meningitis.

To what is the color attributable in this condition? Babinski,[11] in 1903, explained the etiology as diffuse hemorrhagic fibrinous meningitis. Raven regards the cause as multiple small hemorrhages. Hanes[12] believes it due to transudation of blood serum into the pia-arachnoid cul-de-sac, owing to stasis produced by pressure, upon the veins of the pia, at the site of cord compression. The high content of fibrin and proteids and the presence in them of but few cells support this view. Multiple small hemorrhages would tend to produce erythrochromia rather than xanthochromia. The following points of differentiation are noted by Hanes: (1) In the former the color varies from bright red, through varying shades of reddish-brown, reddish-yellow to dark yellow, and varies from day to day; the color in the latter remains the same, and may be amber, cream, straw colored or bright yellow. (2) The former has only a small amount of globulin, with numerous red blood cells and leukocytosis, while the opposite is true in the latter. (3) The former gives a marked benzidene reaction and a distinctive spectroscopic for blood. (4) Fibrin content of xanthochromatic fluids is high, and coagulation may be marked or moderate, which is not true in erythrochromia.

On the other hand, Elsberg and Rockford are not prepared to state that the yellow color is due alone to compression of the cord and stasis of the spinal fluid, for if there were no other factors involved the yellow fluids should have frequently been observed in other cases of slowly progressing spinal compression, such as old fractures and intramedullary growths. These men reported 3 cases of the former and 15 of the latter, with no exanthochromia.

Mestrezat maintains that two factors are esential for the production of this syndrome: (1) The existence of a small, closed cavity, producing stasis of the fluid in which accumulate the elements issuing from the blood; (2) an alteration, infectious or toxic in type, in the wall of the cavity, which so affects the vessels that a transudation process or small microscopic hemorrhages are created. That the closed cavity is a factor may be shown physiologically by the non-permeability of the fluids to colloidal metals. Normally, in ordinary meningitic cases, colloidal metals injected into the spinal canal disappeared rapidly. From the chemical point of view, the existence of a cavity is evidenced by the fact that the albumin and fibrinogens are increased and the spinal fluid is at a standstill and is not renewed as a result of which no absorption of these elements occurs. The question now arises, Did the intensive antimeningococcic serum treatment have anything to do with the production of this peculiar looking fluid? As noted above, the patient in question received 300 cc of the serum intraspinally. Flexner[13] states that in the cases of average severity four to six injections intraspinally, of 30 cc each, are required, while in the very severe cases, injections are to be continued every twelve hours, until the temperature has been normal for three or four days, or until all the symptoms have abated.

If the specific serum were in any way responsible for this peculiar fluid the Nonne-Froin syndrome would be a very frequent occurrence in meningitis, rather than the rare exception that we have found it to be.

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DISCUSSION

Dr. F. G. Ebaugh (by invitation): I feel that Dr. Hirsh's paper is interesting from two viewpoints: The first is the finding of the xanthochromia and the second is the treatment. In a recent study by Leschke xanthochromia was found in 310 cases, of which only 10 proved to be following meningitis. The fact that cisternal puncture as well as lumbar puncture had been done clearly in Dr. Hirsh's case indicated that spinal subarachnoid block was present, in that the cisternal fluid was clear and the lumbar fluid was typically yellow in color and the typical nerve syndrome present. From the viewpoint of treatment his case is interesting. For the past year we have recommended the routine treatment of epidemic meningitis by alternate intracisternal and intralumbar injection of serum. Two cases treated by this method have both recovered. One was a patient of Dr. Sailer's, who was very ill on admission to the hospital. The pathology in Dr. Hirsh's case indicated the efficacy of the treatment. For instance, there was little exudate in the cerebral subarachnoid space, the cranial nerves were not involved and the lumbar cord, etc., was free from any pathology. The pathology was marked in the dorsal region of the cord with a complete subarachnoid block present. The question of multiple injections of serum along the dorsal portion of the spinal canal arises. These have been performed very freely by Ayer, with improvement and recovery in a number of cases. We have performed it in an interesting case of streptococcic meningitis, where we were able to irri-

gate the entire spinal canal. I was also interested in xanthochromia from the standpoint of a factor in prognosis. Wallagren studied 101 cases, in which he found 15 per cent mortality in the cases where xanthochromia was not demonstrated and 40 per cent mortality in cases where xanthochromia was demonstrated. He also recommended treatment by means of the injection of serum in the region of the ventricle or other regions, such as we have offered now by the cisterna magna. I think in the future all cases of this kind should have puncture in the midthoracic region and serum administered.

Arterial Hypotension

BY JOSEPH H. BARACH, M.D.
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It is well at times to free our minds from the fixity of things as they are, and try to see an object in its actual relationship to the complete scheme of things to which that object belongs. A true perspective thus gained will occasionally save us from getting too far from the main road of travel and from going astray.

Because arterial hypertension has been so widely studied, even to having quite a number of books written upon the subject, arterial hypotension has likewise been trotted out into the medical arena, to have its action and its values carefully rated.

Whatever advance has come to medicine through the study of arterial tension, this study was only made possible by the perfected sphygmomanometer. Blood-pressure instruments as well as blood-pressure studies have rendered a signal service to medicine, and we who have used them, each model in its turn, are grateful to Stanton, Nicholson, Faught and others of your own community for their efforts in simplifying and standardizing the sphygmomanometer and making of it a practical every-day instrument, and to Norris, Goodman, Gittings and others for their valuable contributions to the subject.

A noted internist examines a patient and evaluates his disease, and an average practitioner examines a similar patient and places

his estimate upon the case. It is easy to surmise that there will be two widely varying diagnoses as a result of different experiences and breadth of viewpoint. On the other hand, blood-pressure estimations made by these same examiners of totally unequal medical skill will give the same result and have exactly the same scientific value.

One may therefore say that a procedure, no matter how limited its scope, which makes the effort of the most experienced and of the average physician of equal scientific value is advantageous to medicine. Instruments of precision are democratizing the practice of medicine very rapidly. We need more instruments, more methods of precision, more criteria and more standardization, but above all we need correct interpretation of the data furnished by these methods. Great clinical insight will ever remain the genius of a few. But of what good is the science of medicine if it does not reach all the sick in the time of their need?

Arterial tension of a certain height, however produced and maintained, is necessary for propulsion of the blood. Sir James Barr[1] has well said: "Without a certain diastolic pressure, man could not assume and maintain the erect posture. If you hang a rabbit by the ears, after the sympathetic nervous system has been divided in the neck, it immediately dies, because all the blood gravitates into the abdomen. Only for the resistance created to the outflow, by the vasomotor nerves, man would have to go on all-fours."

It is well, then, since there is arterial tension, hypertension and hypotension, that we learn its full significance and what there is for us to do about it.

My discussion this evening deals with arterial hypotension. For a more complete understanding and a broader view of the subject as a whole, I shall present for your consideration some observations upon low blood-pressure, both in health and disease. For the sake of uniformity with the work of others I have adopted the level of 110 mm. Hg. or less as indicating arterial hypotension. Having agreed that 110 mm. Hg. is the high point of arterial hypotension, we may ask ourselves, first of all, What is the fre-

quency of hypotension in health? In answer to this, one should examine healthy groups to determine the incidence of this condition.

Group I.—In 1914, at the Carnegie Institute of Technology, Pittsburgh, we made a study[2] of blood-pressures in 656 students. In this series we found 23 cases in which the systolic pressure was 100 to 110 mm. Hg. and 7 in which the systolic pressure was 90 to 100 mm. Hg., a total of 30 cases of hypotension in 656 normals, an incidence of about 4 per cent.

Group II.—In the summer of 1918, at Camp Sherman, out of a series of 31,596 recruits, 1315 were referred to our cardiovascular board for special study. In this group of 1315 there were 73 cases of pure arterial hypotension. This hypotension group did not include cases of any recognized cardiovascular or any other organic disease. Of these 73 cases we found it necessary to reject 13 with the diagnosis of arterial hypotension, believing that those individuals were incapable of performing the duties of a soldier, the incidence of hypotension for the group being about 5.5 per cent.

Group III.—In this group of 27,224 recruits 1016 were examined by our board. Of these 24 were rejected as in Group II, an incidence of about 2.3 per cent.

Group IV.—In the examination of last year's freshmen at the Carnegie Institute of Technology, Dr. William L. Marks and I examined the records of 1100 males. In this 1100 we found that 15 had had a systolic pressure 110 mm. Hg. and 9 had a systolic pressure of less than 110 mm. Hg. Again, we find an incidence of about 2.5 per cent.

The body weight of these hypotension cases was considerably lighter than that of the others. Compared to standard body weight, 17 out of the 24 averaged 16 pounds under normal for their age and height. Two were normal and 5 out of the 24 were 5 pounds above normal. This underweight indicates the type of individual in whom hypotension occurs.

Another characteristic of the type is found in the chest expansion, which was 2.9 inches for the hypotension cases and 3.1 for the normals.

Group V.—I now present a group illustrating the physical efficiency of this type of case. In 1910 we made a study of 55 Marathon runners.[3] There were 3 cases of hypotension. While all the contestants trained for a period of months prior to the race, we found in the 3 hypotension cases that 1 dropped out within the first few miles of the race, another ran 10 miles and quit and the third ran 13 miles and quit, showing the physical incapacity of these hypotension cases. Two of these 3 were under normal weight. The losers as well as the hypotension cases had smaller chest capacity than the winners. In rating the physical efficiency of the 55 contestants, the hypotension cases were awarded forty-third, fiftieth and fifty-first place

Gorden, Levine and Wilmaers[4] recently reported their observations on a group of Marathon runners in Boston. In going over their figures pertaining to vital capacity, it is to be noted that with the height formula of Hewlett and Jackson as an index of vital capacity the vital capacity of the first to finish the race was above normal. Subdivided in groups of 10, we note that the vital capacity of the first 10 to finish the race was 106.7 per cent of normal. The second 10 was 106.3 per cent, or normal; the third was 104.3 per cent normal; while the figures are not much above normal, they do indicate the tendency.

Discussion. Including the five groups we see that arterial hypotension occurred in about 3.5 per cent of the 4142 males of student and military age. Alvarez,[5] in a group of 6000 male students in California of the same ages as our students, reports an incidence of 2.2 per cent. We found hypotension cases to be considerably under normal weight. Fisk,[6] of the Life Extension Institute, noted underweight to be the predominant characteristic in 70 per cent of the hypotension cases picked out of a group of 17,000 insurance risks. Symonds,[7] reviewing a large group of 150,419 insurance risks, observed that lighter build groups have lower blood-pressure than heavier ones. We found that hypotension cases have smaller chest capacity. Our observations also show that hypotension cases display a marked inefficiency for arduous and sustained physical effort, and that they

are distinctly of the non-athletic type. In the Boston runners referred to the vital capacity was smaller in the third group of 10, who finished last.

At this point I wish to call attention to the observations of Larimore,[8] who made a study of a group of 417 male and female factory workers, whom he divided into four types—the sthenic, hypersthenic, hyposthenic and asthenic type. Hypotension was present in 9.7 per cent of the sthenic males and in 68 per cent of the asthenic males, in 18.8 per cent of the sthenic females and in 64.5 per cent of the asthenic females.

We may therefore say that among normals hypotension occurs in lighter weight individuals of the hyposthenic and asthenic build having smaller chest capacity, and in those who are distinctly of the non-athletic type.

Physiologic Variants Producing Lower Arterial Tension. It is well known that upon reaching high altitudes a series of circulatory changes take place. There is adjustment and readjustment of the respiration and circulation. These changes are produced by lack of oxygen, the result of lowered partial pressure of oxygen.

Likewise at any altitude, in a closed system such as a breathing apparatus, or in a closed chamber, reduction of oxygen supply will bring on all the symptoms of altitude sickness—dizziness, visual disturbances, depression of the nervous system, cyanosis, weakness and exhaustion, headache, nausea, vomiting, thoracic oppression, rapid pulse, air-hunger, a temporary rise and then a fall of blood-pressure. These symptoms come on with varying rapidity, depending upon the physical condition of the subject.

Along with these symptoms of altitude sickness, Greene and Gilbert[9] have shown, by numerous electrocardiographic studies, that oxygen want produces a depression of cardiac function. Rhythm production and rhythm conduction both are interfered with when the oxygen supply falls to a certain level.

A fact well known clinically is that the asthenic, the broad-chested athletic type of individual, adjusts himself to oxygen want quite well, whereas the asthenic type, the hypotension type, stands it poorly. The first effect of the higher altitude

upon blood-pressure is an increase. When readjustment has occurred a sustained increase pressure is never seen. Where the observations have been satisfactorily made there is either a distinct fall or a readjustment toward the normal.

The animal organism accommodates itself remarkably well to diminished oxygen. Lovenhart[11] pointed out that if the atmospheric oxygen were reduced by half animal life would not be interferred with noticeably, but locomotives could not run, illuminating gas would not burn and many highly inflammable substances would be as inert as water.

Hypotension in Disease. Let us now turn to some observations upon the occurrence of arterial hypotension in disease. Of these we will first consider our findings in the acute infectious diseases.

Typhoid Fever. In 1905 I made a series of observations upon 81 cases of typhoid fever;[10] the readings were made four times daily throughout the course of the disease. Hypotension was found present from beginning to end, reaching its lowest level in the fourth week of the disease. The average systolic pressure for the entire group of 81 cases was 93 mm. Hg. in the first week, 92 mm. Hg. in the second week, 83 mm. Hg. in the third week, 83 mm. Hg. in the fourth week, 85 mm. Hg. in the fifth week and 90 mm. Hg. in the sixth week of the disease, as convalescence progressed, with pressure returned to normal.

Influenza. Influenza is the acute infectious disease of the northern temperate zone, in which the blood-pressure seems to reach its lowest level. In September, 1918, I studied the blood-pressure in a series of 50 cases of influenza at the Base Hospital, Mineola, L. I. For the entire group the average systolic pressure was 89 mm. Hg. and the diastolic pressure 53 mm. Hg. The lowest systolic pressure was 72 mm. Hg. and diastolic pressure 48 mm. Hg. In uncomplicated cases the pressure continued falling during the first, second and third day of the disease and began rising on the fourth day. A typical curve is shown on the chart.

First day.	Second day.	Third day.	Fourth day.
115	92	85	112
70	60	60	70
72	60	72	72

The slow pulse accompanying hypotension in influenza is noteworthy. Hypotension occurs in about 3.5 per cent of normal soldiers, but it occurs in 100 per cent of soldiers with influenza.

Acute "Colds." In acute infections of the upper respiratory tract, such as rhinitis and bronchitis, when the patient complains of muscle pains, chilliness, cold hands, cold feet and shivering, with a normal or subnormal temperature, if such a patient's blood-pressure is taken you will find a temporary hypotension.

Pneumonia. In pneumonia there is practically always a marked fall in the blood-pressure; so much so that a well-known rule has been formulated by Gibson which has been said to indicate a bad prognosis if the pulse-rate is higher than the figures for systolic pressure. Experience has shown that this rule is not a reliable guide; it has, nevertheless, called attention to an important phase of the disease.

It is interesting to note that in acute infectious diseases involving the respiratory tract, arterial hypotension is most marked. Even in typhoid fever the respiratory tract is not a negligible factor. In 500 cases of typhoid fever[11] I found symptoms and physical signs of bronchitis in 20 per cent and pneumonia in 5 per cent. Those of us who have treated many typhoids have known the frequency of hypostatic congestion of the lungs.

In these acute infectious diseases there is a tendency to cyanosis, most marked in influenza, a constant tendency in pneumonia and present also in typhoid fever. In typhoid fever it is noticeable in the dusky, fevered face and bluish color under the nails. In these diseases cyanosis and increased respiratory rate indicate the degree of respiratory deficit.

There are other acute infections, among them erysipelas and diphtheria, in which hypotension occurs and in which the mechanism is probably the same. Oxygen requirement is high in all fevers irrespective of the type. We should keep in mind that oxygen want may be produced by a high rate of expenditure, a lower than normal oxygen intake, or both, and that oxygen deficit is the result of diminished vital capacity, a diminution of the respiratory surface and impermeability of a diseased respiratory

mucous membrane. One thing stands out clearly, and that is that in acute infections where hypotension occurs we find evidences of a respiratory deficit and therefore of oxygen want.

Hypotension in Chronic Diseases. Pulmonary tuberculosis is accompanied by a very marked degree of arterial hypotension. All observers are agreed that hypotension is a characteristic of the disease. The degree of hypotension is proportionate to the extent and severity of the disease. In this disease respiratory deficit and arterial hypotension go hand-in-hand.

Anemias are well known to be accompanied by hypotension. In Addison's disease hypotension is said to be most marked. After cardiac decompensation has begun blood-pressure falls.

Diabetes is a disease in which we find both hypotension and hypertension: Hypertension in the type associated with sclerotic vessels, nephritis, etc.; hypotension occurs in those cases in which there has been great loss of flesh and strength and where there is an accompanying weakness. My records in the last eighteen months show that in 118 cases of diabetes 44 had a systolic pressure to 110 mg. Hg., 46 had a systolic pressure of 110 to 150 mm. Hg. and 28 had a pressure higher than 150 mm. Hg.

Hypothyroidism and those inseparable endocrine disturbances corresponding closely to the clinical picture of hypothyroidism constitute a group in this series. All cases in this group had a minus basal metabolism and showed a great tendency to hypotension, irrespective of their obesity. These patients suffer decreased oxidation, which, of course, is different from oxygen want, although the effect upon arterial tension may be the same.

Of 23 such patients 20 had marked hypotension. Their average basal metabolic rate was −10 per cent, but two-thirds of them had a basal metabolism of −15 per cent or more. For the series the average systolic pressure was 99 mm. Hg. and the diastolic was 66 mm. Hg. The average weight for the group was 35 pounds above normal standard.

Discussion. In chronic respiratory diseases, such as tuberculosis, the patient's respiratory deficit comes from the consolidated

lung and muscular weakness, both reducing pulmonary ventilaion. In anemia the oxygen-carrying power of the blood is deficient. In hypothyroidism the oxygen consumption is diminished.

Essential Vascular Hypotension. Let us now consider a group of 100 cases in which arterial hypotension constitutes the most marked abnormality in the individual. This type has been called essential hypotension. (The group does not include recognizable cases of severe anemia, cachexia, pulmonary tuberculosis, Addison's disease, hypothyroidism nor any recognized cardiovascular disease.)

There were in the entire group 40 males and 60 females. Without going into a detailed analysis of symptoms, which would be endless and without profit, and without classifying the various diagnoses that were made in these patients, and which if proved would probably be wrong in about 50 per cent of them, I am going to offer you my general impression of their most marked characteristic.

Taken as a group they are distinctly undersized; they are non-athletic; they have narrow nostrils and frequently nasal obstruction; they have narrow chests and slender bodies; they distinctly belong to the hyposthenic and asthenic type; they have a smaller than normal chest capacity and they have a marked tendency to muscular relaxation; frequently they have drooping shoulders and they are shallow breathers. At times we note irregular breathing; this irregular breathing is similar to the periodic type of breathing seen in newcomers to high altitude, which is plainly due to oxygen want and is promptly relieved by oxygen inhalation.

Arterial Hypotension after Middle Life. In a group of 46 patients ranging from sixty to ninety years of age I find that there were 5 whose systolic blood-pressure did not exceed 110 mm. Hg. I know that some of these had arterial hypotension for many years, and I have seen the blood-pressure recede from year to year, with the advancing atrophy of muscle and subcutaneous tissues. In some individuals of this type I believe the oxidative process throughout their long lives runs on an economic basis, which

would account for their longevity. It is interesting to recall that Fisher, of the Northwestern Mutual Insurance Company found after middle life that hypotension cases live longer than those whose pressure does not exceed 148 mm. Hg.

Summary and Conclusion. In conclusion I would say that the incidence of arterial hypotension is fairly constant and that it is found in about 3.5 per cent of persons in apparent good health. As previously pointed out by others, the individual who has hypotension is physically subnormal and is of the hyposthenic or asthenic type. My strong impression is that he has been endowed with a poor respiratory apparatus.

A normal individual subjected to a diminished oxygen supply as occurs at high altitudes will have a lowering of his blood-pressure. If he is of the sthenic type he adjusts himself well; if he has a poor respiratory apparatus he is sure to experience a more or less severe attack of mountain sickness. All this can be produced artificially in a closed chamber by reducing the oxygen supply.

In the acute infectious diseases, especially those involving the respiratory tract, where a respiratory deficit occurs hypotension is found. In chronic pulmonary diseases and in certain metabolic disturbances where there is a subnormal oxidation, and in other diseases where there is an insufficient volume of blood to carry oxygen as in hemorrhage or pernicious anemia, or where the blood is a poor oxygen carrier, we again find arterial hypotension. All the evidences when correlated seem to point significantly to the deduction that where there is a respiratory deficit and decreased oxydation there do we find arterial hypotension. It is an easy step forward, if one were willing to take that step, to assume that we are here dealing with a cause and its effect. If this holds good in the light of further experience and observations, then in stating the causative factors of arterial pressure we will write that arterial pressure is dependent upon energy of the heart, resistance in arteries and quantity and character of the blood.

We will place before these, and as the first factor, "respiratory effort and oxygenation."

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DISCUSSION

Dr. George W. Norris: We have all much enjoyed Dr. Barach's paper, and I only regret that it leaves me with little to say. As Dr. Barach pointed out at the beginning of his paper, hypotension is a subject on which we all speculate and about which none of us know very much. Compared to the subject of hypertension, the thought given to low blood-pressure is very little indeed. I quite agree with his classification: First of all, concerning "typical" individuals—we all pay more attention to types nowadays, and we see many articles written pointing out the differences in blood-pressure, in the diseases to which they are subject, and the manner in which they react to stimuli of various kinds. One group has congenital hypotension; another is that due to acute and chronic infectious diseases. Here we assume that the cause of the hypo-

tension is toxic. There is another group with terminal fall in pressure among those who had increase in pressure before. The pressure drops from about 200 to a figure which might in some individuals be normal but which in these patients means disaster. Nothing was said, and of course very little can be said, about the *etiology*. In toxic cases it is due to infection and is easily explained. Where it exists in the asthenic type of individual I am unconvinced as to the cause. Associated with visceroptosis this may be the result partly of suboxidation of the blood, but we are not at all sure. It is possible that there is some unknown endocrine factor connected with it. I do not mean just the adrenal glands. These are the organs which enabled man to perform the actions of flight and fight in years gone by, and which in ordinary life are not continuously active. For years Dr. Sajous has been teaching that the adrenal glands have something to do with the way in which the lung handles oxygen. It may be that his theory can be put on a more definite basis and may be linked up with Dr. Barach's suggestions. It occurs to me as a possibility.

As to *treatment*, no general rule can be laid down, as it varies so widely with the type of case.

So far as the asthenic case is concerned it is more or less unsatisfactory. In my experience the best results are obtained through the administration of strychnine, the institution of exercises and the insistence on rest and cold baths. These individuals cannot stand the latter unless trained to do so. If you will start them, first with a hot shower and then gradually from a tepid shower to one of the decreased temperature, until you shock the vasomotor system thoroughly, you will get better results.

One other point is the question of *longevity* in these patients.

Life insurance companies stress the fact that high blood-pressure is a bad thing to have. They say that if you have a pressure of 50 + the mortality will be 60 +, and if more than that the mortality will be even higher. Their statistics indicate readings somewhat different from those accepted by clinicians. They are inclined to construe hypertension on a lower level than we do. The clinician considers a diastolic over 100 is abnormal. The life insurance company finds that over 94 is abnormal. Clinicians accept 150 mm. as the upper normal limit. Insurance statistics point to 140. Hypotension cases in middle life are good risks. The lean horse for the long race, and the man past forty is better underweight than overweight. Statistics show that individuals with a systolic of 100 or close to it have a better average mortality (40 per cent less) than the expected mortality at the same age. So that after all the asthenic individual with low pressure may have something to offset his handicap. It may be that if we want to live longer the best thing to do is to get a good chronic disease and nurse it. It may be that these asthenics do

not have the stamina to stand modern life, hence they take it easily and as a result live longer than the man whose health is so good he thinks he can abuse it so far as working, eating, drinking and smoking are concerned. I think there are many things in connection with this subject that are worth thinking about, and I consider Dr. Barach's a most interesting paper.

Dr. Joseph Sailer: Dr. Barach and Dr. Norris left little to say. There are one or two points, however, on which I wish to speak. In the first place an older person might properly be regarded as a hypertension case when at a figure which would not be considered hypertension in a younger individual.

Second, we should be careful in interpreting the results of mass figures. Blood-pressure in the individual is a variable factor. We have all experienced that in our clinical work. An individual may have high blood-pressure at one time and low at another, and therefore a series of observations taken in a number of individuals may possibly give a false result. If the group of individuals is sufficiently large we may get a fair picture of the average blood-pressure in that group, although the upper and lower limits may differ somewhat in these individuals if examined a number of times.

Third, in the examination of the fairly young, and occasionally in older individuals, we suspect and find that at first the blood-pressure is high and subsequently lower. It is a common observation that a moderate degree of hypotension may appear to be a condition which exists normally. The relation of the type of hypotension to the form of the individual I consider a very interesting subject. Dr. Bryant and Dr. Goldwaithe have done some work on this subject and have ascribed so many qualities to these patients that after reading their article one becomes somewhat confused, and in looking over any group of individuals you find such a great variation of types, even though in the same occupation, that I feel that the whole question of type at the present time has been somewhat overdone. It must be studied from more standpoints than one. Concerning cardioptosis and visceroptosis, on going over the work I reached the conclusion that although cardioptosis is an alluring subject, with much opportunity for speculation, there is little actual knowledge in regard to it.

The same thing may be said of the relation of the endocrines to hypotension. It has been found that there is no relation between the amount of adrenalin in the plasma and blood-pressure. Therefore, it would be folly to assume that a diminution in the amount of adrenalin in the blood serum had anything to do with hypotension. At the present time, where

we cannot measure the thyroid secretion in the plasma, it is rather unwise to assume that hypothyroidism plays an important part in the production of hypotension.

The great value of this paper is, I think, its stimulation of thought on this subject. It brings to mind many questions to be asked, many problems to be solved, and I am glad to have had the privilege of hearing it.

Dr. C. W. Burr: I find this paper interesting on account of my friend, the constitutional neurasthenic. I think there are two classes of neurasthenics—those who are born as such and those who acquire it. They all have small hearts and small bloodvessels. Visceroptosis is very common. The women usually have poorly developed genitalia. They do not have strong sexual desires. The men, though anatomically their genitalia are normal, have great irritability but not great virility. They all have low blood-pressure. It has seemed to me that this is only a sign and not the cause of their being neurasthenic; the whole machinery has been poorly built, and the underlying causes which control the blood-pressure are not strong enough to produce normal strength and vigor.

I have patients who came under my care twenty to twenty-five years ago, when I first started practice, and they are living today; they do not easily contract infectious diseases; their emotions are superficial and not deep; it is remarkable how they live on and die usually of old age.

Concerning hypertension, I remember once early in practice seeing an old man with 200 hypertension. I was much concerned and gave him something to bring the blood-pressure down. As a rule, in these cases no matter what you do the patient lives on. I found, however, experimentally, that if I left these old men and women alone with the high blood-pressure they lived longer than when I tried to interfere with the process of Nature.

Dr. William Stroud: I would like to ask Dr. Barach what he thinks about the subject of hypotension during sleep. I read a paper by Dr. McWilliams, of Aberdeen, and I am wondering whether Dr. Barach has found anything that would lend more knowledge as to whether blood-pressure is elevated or lowered during sleep. I always thought blood-pressure was lower during sleep, but McWilliams thinks it is higher.

Some authorities seem to think that bronchial asthma falls under the classification of Barach of suboxidation. Several men have spoken to me on this matter of low pressure in chronic bronchial asthma.

Dr. Charles C. Wolferth: In view of the importance of the subject and the great interest in what is to me a new hypothesis as advanced

by Dr. Barach, I would like to ask him to tell us a little more in detail what he means by oxygen deficiency. Does he mean oxygen insaturation of arterial blood? Of course, a marked oxygen deficiency occurs in cardiac disease without much lowering of the systemic blood-pressure. There is one more point of clinical interest. It happens that in the medical division of the University Hospital, during the last few years, we have had a number of cases with marked hypotension, systolic pressure of around 70, which after carefully studying the cases we were forced to conclude that the hypotension was in some way connected with a nutritional disturbance; the patients were of the more or less asthenic type; probably greatly undernourished. In one case the nutritional condition was very bad and on simple feeding the pressure rose to 120, having been around 70. This, I think, is of some clinical interest.

Dr. John H. Musser: I think Dr. Barach started something by this paper. As well as Dr. Wolferth, I would also like to hear what he means by oxygen deficiency. One problem which he brought out is the question of the sclerotic individual. In the Philadelphia Hospital you will find numerous cases of men with sclerosed arteries and none of them have high while most of them have low blood-pressures. It probably is a question of capillary fibrosis and sclerosis of the glomerular vessels of the kidney rather than sclerosis of the big arteries. While it may be because of old age that the pressure is low, in spite of this they do keep on living for years. I agree with Dr. Barach about the type of individuals. With individuals of the asthenic type, if you put them in abdominal support and put on weight, the pressure will go up. The question of oxygen deficiency, of which he speaks, brings to my mind the fact that most individuals of the asthenic type usually become short of breath on slight exertion, and I cannot quite follow Dr. Barach's reasoning along these lines.

Dr. J. T. Ullom: I would like to ask Dr. Barach whether he has had any experience in hypotension in pregnancy? I have the impression, although without statistics to back it, that there is apt to be hypotension in pregnancy.

Dr. J. Alexander Clark, Jr.: I would like to ask whether Dr. Barach has noted hypotension in hayfever and asthmatic individuals? We see hypotension frequently in these cases and use it as diagnostic help in doubtful cases.

The low pressure does not exist during the paroxysm of asthma. At such times the pressure is raised considerably.

Dr. Barach (closing): My idea was to see what kind of a response I could get on this subject, and hoped to bring a great deal of information to the surface. I think it is one worth thinking about. Concerning the toxic element in acute infections being responsible for the blood-pressure, I would ask, what are toxins? I do not think we know. The toxic element as a factor in hypotension does not worry me a bit. The fact that hypotension appears in individuals with enteroptosis does not mean anything more; of course, they have a defective state of the digestive viscera, etc. The low blood-pressure is simply a part of the life of the individual who is born subnormal. I did not speak of treatment because before doing that we should know the etiology. Ehatever treatment has been effectual has been in exercise, fresh air, etc. There is no type of treatment especially useful in these cases. Each must be studied individually. In reference to Dr. Sailer's question on mass figures I cannot answer, except to say that we have merely used the figures to show that the disease exists. When you find that 35 out of 1000 individuals have hypotension then they have a disease. The only way we can get disease incidence is by the examination of a large number of individuals. I think our figures are representative. I do not believe hyperthyroidism is active in the production of hypotension. We simply took the cases of hypothyroidism with low basal metabolism and showed that out of 24 cases 21 had hypotension. Take individuals who are 35 pounds above normal: When they sit the pressure would be 40 and when they get up and move around it might be 90. As to blood-pressure in sleep I believe it is lower than normal. I am not in a position to give an opinion on the asthmatics, as I have not had the experience. The nasal obstruction is of importance. I do not want you to think I have built up a theory with any degree of positiveness, but the information on this subject which I have I present for consideration and study.

Tuberculous Meningitis Simulating Encephalitis Lethargica: Report of a Case*

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Notwithstanding the fact that the differential diagnosis between tuberculous meningitis and encephalitis lethargica, as

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given in most text-books, appears to give little difficulty, in actual practice a correct diagnosis is frequently impossible. This is especially true in cases occurring in adults who have been in good health previous to the infection. As is well known, tuberculous meningitis may occur at any age, although it is most frequently seen in childhood. The onset is usually gradual, with signs of a vague and, frequently, slight illness. There is usually a rise in temperature, headache, vomiting and, frequently, constipation. The pulse is slow and irregular, although it may be rapid at the onset. After a variable period the patient exhibits dulness, drowsiness, lethargy or stupor. Convulsions may occur, and at times there may be rhythmic contractions of various muscle groups. On examination the muscles of the neck may reveal rigidity, with resulting retraction of the head. The cranial nerves are frequently involved, due to involvement of the meninges at the base of the brain by the tuberculous process. As a result, various palsies occur, especially palsies of the ocular muscles. Kernig's sign is often present. In 17 of 23 cases of tuberculous meningitis in adults where this sign was looked for, Landis states "It was present to a marked degree in 14 and definitely absent in 3."[1] The reflexes are variable. The correct diagnosis depends upon a painstaking examination of the cerebrospinal fluid. The fluid is usually under pressure, clear or turbid, often forms a clot on standing and shows a reduction of normal sugar. A pleocytosis with a high proportion of lymphocytes is a common finding. The demonstration of the tubercle bacilli by stained smears or by animal inoculation is, however, conclusive. The illness is usually fatal within a period of three weeks. The close clinical similarity to certain forms of encephalitis lethargica will be seen from an epitome of the chief features of this disease.

Encephalitis lethargica may occur at any age. It is more prevalent in the winter months. The onset may be insidious or abrupt, and usually appears as a general infection, followed by nervous manifestations. Symptoms indicative of lesions of the

[1] Med. Clin. North America, 1920, iii, 1377.

brain, particularly the gray matter of the basal ganglia and brain stem, are important features of the disease. Headache and double vision are common. Paralysis of any cranial nerve may be met with, but involvement of the third, fourth and sixth is most frequent. Lethargy, while occasionally absent, is present in the majority of cases, in which instances the patient can be easily aroused. Irritability often occurs. Delirium is a common symptom. Myoclonic movements of various muscle groups may occur. Meningeal symptoms may be present. The reflexes are variable.

The cerebrospinal fluid is usually clear. The pressure is normal or slightly increased. The cell content is normal in about one-third of the cases, while in the remainder there is a pleocytosis averaging 20 to 30 cells per 1 cm., the lymphocytes predominating. The reducing bodies do not disappear and the globulin may be normal or slightly increased.

The course of the disease is usually irregular and prolonged. With severe symptoms the termination may be rapidly fatal, while if the disease extends beyond a period of three weeks recovery is probable. There is often a recurrence of symptoms. Permanent changes in various parts of the nervous system with resultant symptoms may occur as sequelæ. It will, therefore, be seen, that the diagnosis depends upon careful and repeated examinations of the cerebrospinal fluid.

Case History. The patient, A. C., aged twenty-two years, an Italian housewife, mother of two healthy children, had been ill for seven days before coming under observation on February 18, 1923, when she complained of severe headache, double vision, difficulty in speech and pain in the right arm. On the second day of her illness her speech became unintelligible. On the following day her hearing became impaired. The double vision, at first transitory, became persistent on the third day of her illness. The fever was present from the time of onset. Of interest in her personal history was the fact that she had a cough, which had persisted for the past six or seven years, and which would become

aggravated during the winter months. The cough was slightly productive, but hemoptysis had never occurred. In April, 1922, she had an attack of pleurisy, with effusion on the right side, for which she was tapped.

Physical Examination. When first examined the patient was well nourished, stuporous in appearance, but would become noisy occasionally. Her pupils were dilated, regular in outline and reacted sluggishly to light. There was convergence of the eyes. Visible pulsation was evident at the suprasternal region. The muscles of the neck were not rigid. The chest examination was negative. The heart was negative for pathologic findings, except for an accentuation of the aortic sound. The heart and pulse-rate was 120 per minute. The tension of the radial pulse was increased. An examination of the abdomen revealed no abnormality. The extremities were fully extended, and on examination revealed a tendency toward Kernig's sign in the left leg. The temperature was 102° F., and the blood-pressure was 130 mm. systolic and 80 mm. diastolic.

Three days later the patient was admitted to the hospital, to the service of Dr. T. McCrae. The temperature was 103.4° F., the pulse 120 and respirations 24 per minute. She was quiet and obeyed simple commands. The convergent squint became pronounced. The day following admission the convergence was more marked in the left eye. A slight palsy on the left side of the face was noted.

Ophthalmologic Report (by Dr. Charles R. Heed): "Media clear, the disk margins slightly blurred. The veins full and moderately tortuous. The retina visible and edema apparently present. The pupils 5 mm. and reacting promptly to light and convergence. External rotation impaired in both eyes, indicating a double sixth cranial nerve palsy."

The fluid obtained by lumbar puncture at this time was not under increased pressure. The fluid was slightly turbid. The globulin was much increased. Fehling's solution was not reduced. The cell content was 405 cells per 1 c.mm., the large mononuclears

predominating. The Wassermann reaction was negative. On this date the patient showed generalized rigidity.

Five days after admission the patient's cerebral symptoms became aggravated. There were alternating periods of restlessness and stupor. The convergent squint became still more marked and the facial palsy on the left side became more pronounced. Definite ptosis of the left eyelid appeared and a slight ptosis of the right eyelid was noted. The muscles of the neck became rigid, but there was no marked retraction of the head. The reflexes were variable, but in general diminished. No Kernig sign or Babinski reflex could be elicited. Ankle clonus could not be demonstrated. The patient kept her legs now in a flexed position. There was no evidence of myoclonic contractions. The temperature was 104° F., and the pulse 130 and respirations 28 per minute.

The second lumbar puncture revealed the following: Fluid was under pressure, slightly turbid. Fehling's solution was not reduced and globulin was increased. The cell count was 430 per 1 c.mm. Tubercle bacilli were demonstrated for the first time.

A sixth and third cranial nerve palsy on the left side was present. Eight days after admission to the hospital the patient died. The blood Wassermann and urine examinations were negative.

Summary. (*a*) The patient exhibited multiple cranial nerve involvement, lethargy, absence of muscular rigidity of the neck and absence of Kernig's sign.

(*b*) Presence of tubercle bacilli on the second examination of the cerebrospinal fluid.

Conclusion. This clinical history emphasizes the importance of careful and repeated examinations of the cerebrospinal fluid for tubercle bacilli in patients exhibiting the symptomatology of encephalitis lethargica.

DISCUSSION

Dr. C. W. Burr: When your secretary asked me to discuss this paper I told him the only thing I could say was that in atypical cases the

differential diagnosis was impossible, and he said he thought that would be something well worth saying. He seemed to think, and I am quite sure, whether Dr. Bernstein thinks it or not, that there are not a few doctors who think it is the easiest thing in the world to diagnose encephalitis lethargica, that all cases are alike and that if you make a mistake in this diagnosis you ought to be ashamed of yourself. I am consultant in the Children's Hospital and I have made mistakes on both sides. I have said a child had tuberculous meningitis and at autopsy it turned out to be epidemic encephalitis, and also, I have said a child had epidemic encephalitis and at the autopsy it proved to be tuberculous meningitis. The typical cases are quite easy. When a child or adult who without any long prodromal symptoms, and while apparently in good health, develops fever (usually not above 102°), headache, is very somnolent, has double vision, with no signs of meningitis, I think we are safe in saying that it is going to prove at autopsy to be encephalitis; but in the difficult cases I think a very important point in differentiating between them is the difference between the stupor of meningitis and the somnolence of encephalitis. Unfortunately you can have profound stupor in encephalitis and you may have a light stupor simulating somnolence in tuberculous meningitis, but, as a rule, I think you will find that the condition in encephalitis looks like sleep and not like a coma or stupor, that the position of the patient in bed is more natural, that very little stimulation is necessary to bring him out of it and that his attention can be held and he will talk to you. As soon as all external stimuli cease he will go back again to sleep. This, however, is not an absolute rule, and in not a few cases there is a stupor which is indistinguishable from real stupor. However, in my own experience I find it a useful guide.

The other thing is the laboratory test. A good many of you have heard me speak of this many times and have heard me say that the laboratory tests should come last, and our own powers of observation should come first, but I think it is pretty well proven that in epidemic encephalitis there is a great increase in the sugar content of the spinal fluid. One of our young men, now an interne in the Orthopedic Hospital, while in a New York institution, not only reviewed the literature but examined the spinal fluid in 30 cases, and then had controls from acute meningitis in other causes, and he found an invariable marked increase in the sugar content, and the early investigators all found this same increase; and I think if conditions are such that you can make a spinal-fluid examination it is a very important thing.

One other thing is the matter of the prodromal period in tuberculous meningitis. All the text-books say that in children the average duration

of tuberculous meningitis from the time it is possible to make a diagnosis is three weeks, as death occurs on an average at the end of that time. However, this statement is made on the basis of hospital statistics and for hospital patients, and therefore concerns a class that cannot give any real medical history before they are desperately ill. Certainly, in the average patient who comes to the PhiladelphiaHospital the parents are the type of people who do not regard the child as ill until he has either convulsions, paralysis, stupor, etc. Among private patients of the more intelligent class, if you take statistics, I think you will find that in the greater majority of patients with tuberculous meningitis (and by these patients I mean children) that long before this great outburst of serious symptoms there is a period of bad sleeping, bad eating and the patient looks generally sick, a general condition which if seen in an adult would make one think of a possible neurasthenia. In these cases I note that there has always been a little fever, 99.4° or 99.6°, and that the temperature has lasted over a period of weeks before anything happened that would make the physician say "the child is going to develop or has developed a tuberculous meningitis." I have seen this happen so often that now whenever a child is brought to me because it is tired-out I first have a medical man go over it and take its temperature night and morning, and not a few times, even if the child is not regarded as seriously ill when brought to me, I have seen it a month or two later suddenly develop all the symptoms of meningitis and die.

The long prodromal stage does not occur in epidemic encephalitis. There is no history of days and weeks of malaise, and the thing usually strikes like a thunderbolt. So that I think the past history, when we can get it, is very important.

No matter what care you take you are bound to make mistakes in diagnosis, and I think that Dr. Bernstein will find that he will make mistakes again in the future.

There is nothing pathognomonic about it, it is a question of balance, and sometimes the balance is so equal that you cannot tell which condition is present. The theory that the presence of a meningitis excludes the possibility of encephalitis is absolutely wrong.

Dr. A. I. Rubenstone: In the differential diagnosis between tuberculous meningitis and encephalitis lethargica the examination of the spinal fluid is of the highest import. My experience has been that protein content in tuberculous meningitis is high from the start. This is not so with lethargic encephalitis. In the examination of clear spinal fluid with high protein content syphilis and tumor are the two only other conditions

that have to be excluded. In syphilis the Wassermann test will help differentiate it and in tumor the cell count is relatively very low. Encephalitis rarely gives you such high protein estimation.

With reference to velum formation, it is always best, when clear fluid is obtained, to put one tube away undisturbed to watch for a thin velum formation. While tubercle bacilli, of course, can be demonstrated in every case of tuberculous meningitis before the fatal outcome, velum formation occurs very early, and it is very important in a differential diagnosis.

In tuberculous meningitis sugar reduction disappears very early. This, however, is not a pathognomonic sign, for in 2 cases of tuberculous meningitis that came under my observation sugar reduction was present until the disease was far advanced. Therefore, the sugar reduction is of some diagnostic value, but is not absolute in differentiating tuberculous meningitis from encephalitis; but I believe the higher protein content, the higher cell count, as well as velum formation in tuberculous meningitis, are really useful signs in doubtful cases. The pulse, although not absolutely diagnostic, is, I think, sometimes helpful. In tuberculous meningitis there is a tendency to irregularity, relatively slow and sometimes a tendency to dicrotism.

Dr. A. Trasoff: I have seen about 18 cases in which the velum formation was always present within two or three days in tuberculous meningitis. One case was suffering from severe headache for two days and was punctured, and in two or three hours we found a beautiful velum formation. In almost all cases if you leave them long enough in a small container you will find this characteristic.

Dr. Herman B. Allyn: I am tempted to refer to an unusual case of my own occurring in the hospital several years ago. The man was a Chinaman and had been ill for two weeks with headache, ocular palsy, paralysis of the third to seventh nerve, some rigidity of the neck, Kernig's sign and retention of urine. Spinal fluid was cloudy. Three examinations of the spinal fluid were made and all reported to me by the laboratory to be negative for tubercle bacilli. There was a history of his being quite sleepy and drowsy and semicomatose, but he could be roused and could talk. Before autopsy the case was thought to be encephalitis lethargica. At autopsy no tubercles were seen, but when a portion of pia was snipped off and stained, tubercle bacilli were found. The difficulty was in the age of the patient, and because of the fact that there is an inflammation of the brain in both diseases. After the autopsy findings were reported the laboratory said that it had reported one of the examinations of the spinal fluid as containing tubercle bacilli.

MAY 19

The Anatomy, Clinical Syndromes and Physiology of the Extrapyramidal System[1]

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The subject under consideration is a rather difficult and extensive one, and I agree with most of the authors, especially S. A. K. Wilson, that nearly all problems in connection with it are still unsolved. I will, however, attempt to explain my own conception of the extrapyramidal system and of its lesions.

Disorders of Motility It is well known that *all extrapyramidal diseases have this factor in common—they all present characteristic disturbances of motility associated with changes in muscle tonus.* These disorders of motility can be definitely differentiated from the pyramidal tract, and three forms can be distinguished, all of which are manifested in the course of voluntary, automatic and reflex movements. These three forms are: (1) Hypokinesia; (2) diminished or increased muscle-tone states, manifesting themselves in either hypotonia or hypertonic rigidity; (3) hyperkinesia.

1. The *hypokinesiæ* consist of failure of innervation during voluntary movements (mild paralysis), consisting of a slowing of the beginning of the execution and of the excursion of a movement with easy fatigability. Then there occurs a failure in the automatic physiologic association which, under normal circumstances, complete and "round out" voluntary movements. There also occurs a peculiar lack of reactive movements which follow reflexly all afferent sensory stimuli. (Such movements are: Movements

[1] This paper constitutes part of my lectures on neurohistopathology, given under the auspices of Columbia University, New York (April 7 to May 1, 1924), and is a complete description of my lecture given May 13 before the Section of Neurology and Psychiatry, New York, and before the Section of Medicine, College of Physicians of Philadelphia, on May 19, by invitation. It is a review of my book *Die extrapyramidalen Erkrankungen mit besonderer Berücksichtigung der Pathophysiologie der Bewegungsstörungen* (Julius Springer, 1923), which contains the literature and many illustrations.

of defence, protection, flight, fear, automatic orientation, arrested attention, movements of expression and gestures.) Finally there occurs a failure of "assisting" movements—movements that usually accompany automatically every purposeful act, such as sitting, standing, walking, chewing, swallowing and talking. These are movements that insure an undisturbed synergy in all acts of motility.

2. The disturbances of muscle tone, *i. e.*, the state of muscle tenson which the entire skeletal musculature assumes without any voluntary innervation during rest, attitude and position, may appear in the form of hypotonia, as in chorea or in the form of rigidity of individual groups of muscles. This form includes the increase in the permanent, plastic, form-giving muscle tonus commonly designated as rigidity which accompanies increased passive resistance to muscle stretching, delayed muscle "after-contraction," adaptation and fixation tension, with the peculiar anomalies of posture and attitude. All these phenomena of rigidity or hypertonicity play a significant rôle in the cataleptic attitudes of these patients in adiadokokinesis, in propulsion and retropulsion, as well as in voluntary movements where they give rise to a slow incomplete execution and repetition of movements. Finally, we have here the various forms of tremors and shaking phenomena of disturbed coördination which are apparently due to improper innervation of the antagonists.

3. The *hyperkinesiæ* appear in the form of the well-known choreiform and athetoid motor restlessness, torsion spasms, hemiballismus, tics and myoclonias. Chorea and athetosis are to be regarded as associated, and expressing movements consisting of two components: (*a*) The increased or hyperkinetic and (*b*) the dissociation of ataxic component.

Choreiform hyperkinesia is a distorted and exaggerated physiologic movement and parakinesiæ are involuntary complicated movements which resemble the voluntary expression movements. Athetosis also is a distorted and at the same time exaggerated associated and expression movement, in which the disruption of the lower tonic and static functions is predominant. We believe

that the manifestations of torsion spasm and torsion dystonia form a separate subtype of athetosis. *Torsion dystonia* is characterized by the presence of irregular, arrhythmic, convulsive movements, resembling involuntary movements, in extensive parts of the body, during which extreme twistings (torsions) of the trunk, spinal column and proximal ends of the extremities are the predominating features. Spastic torticollis, with its, at times, rhythmic and, at other times, irregular appearing spasms of the muscles of the neck, is a partial manifestation of torsion dystonia. The term *hemiballismus* is employed to designate the uncontrollable, incoördinated, twisting, massive movements involving an entire half of the body with an exquisite tendency to twist and roll the body. Myoclonia and tic closely resemble chorea, but are limited to individual muscles or muscle groups.

Clinically we can distinguish three syndromes: (1) The choreiform, (2) the akinetic-hypertonic (Parkinson) and (3) the athetotic. The diseases belonging to these three syndromes have as their anatomic basis an affection of certain definite parts of the basal ganglions. The entire gray substance in this anatomic region is designated the extrapyramidal system, and the motor disturbances due to disease of these centers are called extrapyramidal motor disturbances. But since in addition to the extrapyramidal system as represented by the basal ganglions there also exists a second mechanism subserving extrapyramidal motor coördination in the form of the frontopontocerebellar system, we designate the former as the principal extrapyramidal system. Of course, designation is only for the sake of brevity and is not meant to imply that the other extrapyramidal system is not as important as the principal one. Here, however, we shall limit ourselves to the latter.

The extrapyramidal system consists, in its main subdivisions, of the following gray nuclei: (1) Striatum (nucleus caudatus plus putamen), (2) pallidum, (3) corpus Luysi and (4) substantia nigra Soemeringii. The red nucleus, too, indirectly belongs to this system. A study of the anatomy of the whole system, especially the interrelations of the single centers, reveals the follow-

ing facts: The striatum, which represents as its main subdivisions the nucleus caudatus and the putamen, is genetically and morphologically a uniform mass, developed out of the same matrix as the cerebral cortex (alar plate of the prosencephalon), and is essentially also constructed like it. In its cell structure it shows two types of ganglion cells—infrequent large ganglion cells among numerous smaller cells. This nucleus derives its stimuli from special zones in the thalamus, and its outgoing fibers terminate in the pallidum. Only, with C. and O. Vogt we have to assume that the afferent fibers terminate in the vicinity of the small ganglion cells and that these then exert their influence on the large long axon cells and from these the striofugal fibers originate and transfer the stimulation to the cells of the pallidum. The striatum thus appears to be a highly developed regulating organ endowed with cortical characteristics and superior to the pallidum, *i. e.*, a special cortex to the pallidum.

The pallidum is a simply constructed gray nucleus, which must ontogenetically be assigned to the hypothalamic portion of the diencephalon; it is developed out of the ground-plate portion of the prosencephalon and contains only one kind of ganglion cell. The pallidum is rich in fibers which appear to be of a variety of types: (*a*) Afferent types coming from the same thalamic areas as the afferent strial fibers and (*b*) fibers from the striatum itself. The latter are extremely complicated and numerous.

Pallidofugal fibers (*a*) connected with particular zones of the thalamus and (*b*) hypothalamus. The latter consists of numerous fibers to the capsule of the red nucleus, to the corpus Luysi, to the substantia nigra, to the nucleus of the posterior commissure and to the oral part of the pons.

The corpus Luysi or subthalamicum has ontogenetically the same matrix as the pallidum and has a ganglion-cell structure similar to that of the pallidum. It is an almond-shaped, sharply delimited gray nucleus of the hypothalamus, deriving its chief afferent fibers from the thalamus, especially from the pallidum, and sending numerous fibers to the capsule of the red nucleus and into the substantia nigra.

The substantia nigra is a macroscopically visible gray mass, lying at the foot of the pes pedunculi, divisible into two different constructed zones: (1) A zona compacta lying dorsally and provided with characteristic large ganglion cells containing melanin and (2) a zona reticulata, lying under it and constructed like the pallidum. The substantia nigra is the only one of these centers that possesses direct cortical fibers coming from the centralis anterior, operculum and the posterior part of the frontal lobes. The substantia nigra also contains richly developed connections with the pallidum, corpus Luysi, the red nucleus and the thalamic nuclei. Descending fibers extend from it to the pes pedunculi, the anterior part of the corpora quadrigemina and geniculata and the lemniscus area of the tegmentum-pontis.

The nuclei of the posterior commissura, nuclei Darkschewitschi and interstitialis receive their impulses from the nuclei of Deiters and Bechterew and give origin to the posterior longitudinal bundles. The posterior longitudinal bundle constitutes that phylogenetically old connecting and reflex tract which is always encountered at the same location, and which, extending through the whole brain system, descends into the cervical cord (anterior horn). It establishes interrelations between the nuclei of the eye muscles, and brings the vestibular apparatus into relation with the pallidum, the nuclei of the eye muscles and the spinal cord. It is to be regarded as the important coördinating tract of the whole motor apparatus of the midbrain and brain stem, including the nuclei of the eye muscles.

In the tegmentum of the midbrain and brain stem we have, as is shown by the valuable experimental work of Magnus and his school, a motor apparatus of great importance both for animals and man. This apparatus seems to be connected with the posterior longitudinal bundle, and when stimulated proprioceptively controls, by virtue of the manifold reflexes of position and station, the harmonious distribution of the bone throughout the body musculature, and regulates the precision of motions and positions. This powerful coördinating mechanism operates, according to the experimental results of Magnus, largely independently of the

cerebellum and the higher cerebral centers. This is true not only in lower anmals, but even in monkeys.

The red nucleus, the fibers of which are elaborately and intimately bound up with the pallidum as well as the corpus Luysi and substantia nigra, is to be regarded as the oral hypertrophy of this whole motor apparatus, the latter apparently consisting of several superimposed layers. It is the most important organ of tone in this group, and must be regarded as playing an important rôle in the function of posture and as the special center for normal tone distribution. The rubrospinal tract of von Monakow, originating in the magnocellular portion of the red nucleus and crossing mostly in the decussation of Forel at the level of the red nucleus, is the efferent tract for these functions to the anterior horns of the spinal cord.

The red nucleus is also the chief terminal station and passageway of the dentatum tract, and is, therefore, an efferent cerebellar nucleus. As such it carries impulses from the cerebellum to the coördinating mechanism of the midbrain. In the higher animals we find, in addition to the large cells, a portion provided with small cells, intimately connected with the frontal lobe and increasing in complexity as we ascend the animal scale and reaching its maximum in man. The red nucleus is therefore a projection center for the cerebellar impulses to the frontal lobes.

Finally, the red nucleus, by virtue of the highly developed pallido and corpus Luysi rubral fibers, also serves as an important connecting nucleus between the striopallidum and corpus Luysi and the motor coördination apparatus of the brain stem.

This motor coördination apparatus of the midbrain and brain stem, together with the red nucleus—as the center of all reflexes of tone station and posture—are therefore under a double influence and stabilization (Sicherung): On the one hand, under the cerebellar influence through the dentatorubral tract; on the other hand, under the influence of our extrapyramidal system.

It is evident that the consideration of these anatomic and physiologic facts is of utmost importance for the elucidation of the complicated conditions of human pathology.

The following fact is of equal importance: The efferent pallidal fibers run principally to the lower centers of the homolateral side, but partly also to the contralateral side. Thus we have a bilateral extrapyramidal innervation, which through the crossing of von Monakow's bundle innervates mostly the contralateral side.

It must be borne in mind that the pathologic process in the human being, for reasons not as yet clearly understood, behaves differently from the physiologic phenomena observed in animal experimentation by the Magnus school and others. So we see that in the lower animals—the only material that can be employed in the Magnus experiments—the removal of the centers lying orally to the red nucleus produces no characteristic changes in tonus or disturbances in locomotion, just as the experimental destruction of the substantia nigra region in animals results in no marked interferences with tonus and postural function. On the other hand, injury to the extrapyramidal centers in man is accompanied by grave disturbances in tonus and in movements of an extrapyramidal character.

A study of the more or less regularly occurring changes in these gray centers and the extrapyramidal syndromes and maladies resulting, yields the following data:

Chorea. The chorea syndrome is seen in its purest form in *chronic progressive chorea, Huntington's disease,* with the demonstrable hereditary influence, as well as that form which resembles it clinically, but has no demonstrable heredity or known etiology. Both these forms are, in my experience, related to definite anatomic and histologic findings. Pathologically, chronic progressive chorea has as its basis a diffuse and purely parenchymatous degenerative process extending over large areas of the central nervous system—and showing predilection for a particularly serious degeneration in certain definite parts. It, thus, invariably finds its main localization in the striatum, especially in the caudate nucleus, resulting in a marked degeneration and eventual disappearance of the small ganglion cells. Ramsay Hunt was the first to recognize this fact.

I have had the opportunity to examine anatomically an "abor-

tive" case of Huntington's chorea of two years' duration, in which the movements were more those of parakinesis than of chorea. In this case I found a definite but milder degeneration of the small ganglion cells of the striatum. We can say, therefore: In milder affections of the striatum more complicated parakinesis closely resembling normal gestures may predominate over the choreic restlessness.

In Dunlap's laboratory at Ward's Island, N. Y., I saw several cases in which this author demonstrated the same changes.

The following case is also of interest: The clinical picture was that of choreiform disturbances lasting for nine years, when the hyperkinesis gradually subsided and was replaced by marked rigidity and definite dysarthria followed by contractures of all limbs. Anatomically, the striatum and pallidum showed a disappearance of all the small ganglion cells and a considerable involvement of the large cells. In a milder form these same changes were also found in parts of the zona reticulata of the substantiæ nigræ. We can conclude from this that the choreiform movement, disturbances, etc., are transformed into the akinetic-hypertonic syndrome of Parkinson as the degeneration of the striopallidum progresses, the large ganglion cells also becoming involved and the subpallidal centers joining the process.

In the cases manifesting psychic disturbances the cortex participates in the degenerative process. In most of these cases the affection involves the frontal lobe and the centralis anterior, with the appearance of a peculiar glial pseudonuclear layer in the latter situated above the pyramidal or Betz cell zone. In the affected areas there occurs a marked degeneration of the internal nuclear layer and the three lowest cortical layers.

This histologic picture is to be regarded as specific for chronic progressive chorea in connection with its characteristic localization.

The view that the locomotor disturbances in chronic progressive chorea are located in the striatum receives material support from the phenomena of *toxic infectious chorea* (*Sydenham's chorea minor*) and of symptomatic chorea, dependent on various etiologic

factors. In all these cases there occur distinct, usually focal, alterations in the striatum. In these cases, however, unlike chronic progressive chorea, the small ganglion-cell degeneration in the striatum is not as a rule emphasized to the same extent. A simple answer to the question of localization in these cases is, in view of the usually diffuse character of the manifestations, extremely difficult. The positive findings in the striatum in all such cases, however, lend considerable support to the theory presented herewith. This applies equally to toxic-infectious chorea, which develops with special frequency after articular rheumatism and which is to be attributed partly to embolic and partly to infiltrative and degenerative focal processes, similar in character to the choreiform complications of epidemica encephalitis and the well-known changes accompanying this disease. A general diphtheritic infection may give rise to a symptomatic chorea, as was seen in a case examined by Globus in my laboratory; in this case the grave parenchymatous degeneration was limited to the striatum. Chorea gravidarum likewise depends on embolic lesions in the bloodvessels of the striatum.

In *general paralysis* also the occasional choreiform movements that may occur during the course of the disease would indicate extremely marked alterations in the striatum. We may also postulate that certain components of paralytic speech—and locomotor disturbances—may be referred to the usual alterations in the striatum.

This is also true of symptomatic chorea, in tumors and in cerebral diseases based on syphilitic or *arteriosclerotic bloodvessel disease.* I have examined a patient with apoplectiform facial tic of one side and anatomically found an arteriosclerotic cyst in the capsule of the caudate nucleus of the opposite side. Finally, such a condition may occur in multiple sclerosis and tuberous sclerosis when a corresponding area in the striatum is involved.

Senile chorea, an atypical form of a grave senile dementia, must also be placed in this group. There are cases in which the process of senile involution is markedly developed in the striatum as well as in the cortex, in which case the changes in the striatum repre-

sent in a certain sense a mild form of the disturbances that we encounter in genuine paralysis agitans. To illustrate, I can cite a case of senile dementia in which a tremor, subsequently developing into a generalized chorea, was superimposed on a psychosis. The chorea was then followed by a marked rigidity of the lower limbs and a chorea at rest in the upper part of the body.

Anatomically, I found in this case the typical and marked senile changes in the striatum and pallidum, the pars anterior of the striatum showing a milder form of degeneration than the pars posterior. In the latter all ganglion cells, the small and the large, were involved; some of them had disappeared and others showed marked degeneration. The clinically manifested chorea of the upper part of the body corresponded to the milder degeneration of the pars anterior striati, and the Parkinsonism of the lower part to the severe degeneration of the pars posterior striati. Senile chorea represents to some extent a connecting link between paralysis agitans and the locomotor disturbances of senility which are likewise localized in the striatum. The relation is emphasized by the fact that such senile choreas develop from a tremor and may terminate in partial or complete rigidity.

The clinical entities that are characterized by Parkinson's hypokinetic-hypertonic syndrome stand in sharp contrast to these varieties of chorea, as far as symptoms are concerned.

Parkinsonism is seen in its purest form in genuine *paralysis agitans;* it is anatomically dependent on a degenerative process which is akin to a process of senile involution, particularly with fatty degeneration of the neural parenchyma and degeneration of the large ganglion cells. This process is, as a rule, located chiefly in the striatum and in milder forms in the pallidum. In contrast to chorea, it is especially the large cells in the striatum that degenerate and are destroyed. In exceptional cases the substantia nigra (zona compacta) may participate in the degenerative process. The pathologic process may be accompanied by an intense capillary fibrosis and lesions resulting therefrom. In cases with unilateral predominance of the clinical symptoms we have anatomically also a more severe damage of the striopallidum of the opposite side.

Closely akin to this clinically is Foerster's *arteriosclerotic muscle rigidity*, the lesions of which, determined by sclerotic vascular changes, are located in what apparently seems to be two favorite sites: At times there are definite vascular lesions in the fronto-pontocerebellar system; at others, in the striatum and pallidum and ultimately commingled with such processes in the substantia nigra.

Histologically, *senile muscle rigidity with dementia* must be carefully differentiated from these maladies (A. Jakob). This disease must be regarded as an atypical form of senile dementia, and represents, clinically and anatomically, a peculiarly grave end-process of a typical senile cerebral process in the basal ganglions, especially in the striatum and in the pallidum. Corresponding to the clinical locomotor disturbances and in keeping with the gravity of the senile involutionary process in the striatum and in the pallidum (rarely also in the substantia nigra) in senile and presenile psychoses (and in Alzheimer's disease), there are found plastic transitions from the locomotor disturbances of the ordinary senicum and those of Alzheimer's disease and senile chorea to senile muscular rigidity.

Similarly localized in the striatum and pallidum, are those Parkinsonian syndromes which not infrequently develop in syphilitic vascular changes, diseases resembling general paralysis, running a strikingly slow course and with variable serologic reactions at different times, mostly mildly positive or even negative (in blood and spinal fluid). In these cases the vascular changes can be differentiated only with difficulty from typical arteriosclerosis, but usually the more intense vascular infiltration points to a syphilitic origin, as do the proliferative changes in the cells of the vessel walls—findings characteristic of endarteritis luetica of the small bloodvessels. Congenital syphilis may give rise to such clinical pictures in childhood. We frequently find in these cases, in children as well as in adults, a bilateral necrosis of the striopallidum.

At present we frequently meet *Parkinsonisms following epidemic encephalitis.* I have made most careful anatomic and histologic

studies of five such cases, all of which showed almost identical symptoms, and have made the following observations with regard to localization: In the first case, which I published in 1921, the substantia nigra was greatly degenerated in the zona compacta; so was the pallidum, and, with diminishing intensity, the striatum, with conspicuous degeneration of the large ganglion cells. In two other cases the intense degenerative process was limited essentially to the zona compacta of the substantia nigra. In the fourth case there was in addition to the grave degeneration of the zona compacta of the substantia nigra an almost equally serious degeneration of the pallidum, and in the fifth case the striopallidary degeneration exceeded the manifest, but receding, alterations in the substantia nigra. We see then that in individual cases of this disease the localization of the process may vary within certain limits but that the usual affection of the zona compacta of the substantia nigra stands in the foreground. These conclusions agree with the observations of K. Goldstein of the French School (Tretiakoff Lhermitte and Cornil) and the American authors, all of whom emphasize the constant and, almost invariably severe affection of the substantia nigra. More recent investigations in Russia and Italy point to similar changes in the striatum and pallidum, in addition to the disease of the substantia nigra, as in my first case. At any rate, we are justified in saying today that the *malady commonly spares the cerebral cortex and finds its chief location, as a rule, in the substantia nigra. From this it also follows that a degeneration of this gray area may condition a Parkinsonism*, as Brissand probably thought as far back as 1895.

As I have already explained, on the basis of my first case, there is at the bottom of these cases a progressive and almost purely degenerative affection of certain gray centers, although on rare occasions it is possible to establish a mild lymphocytic infiltration of the bloodvessels. But we may assume that the acute and subacute processes of epidemic encephalitis (which, as a rule, favor the substantia nigra) bring about changes in these gray nuclei, which practically recover from the inflammatory and infiltrative component but go on to a progressive nuclear degeneration.

But there is evidently a second and much rarer group of after-effects of epidemic encephalitis with a much more varied symptomatology and course; in such cases—often with a clinical picture of *pseudobulbar palsy*—we find a fairly extensive degenerative process (cortex and white matter, striatum, pallidum, thalamus) accompanied by a fat granular-cell formation and more marked infiltrative vascular phenomena. The abortive type of metencephalitis chronica has been studied only clinically.

Finally, we have a Parkinsonism representing the clinical picture of *Wilson's disease* and *Westphal-Strümpell's pseudosclerosis.* These, as we know, are diseases of adolescence with special emphasis on the constitutional component, in which there is almost always combined disease of definite central nerve nuclei, a peculiar cirrhotic change in the liver and commonly extrapyramidal locomotor disturbances, together with more or less marked psychic changes. These two types of disease, between which there are plastic, clinical and anatomicohistologic transitions, offer us a pure degenerative process in the parenchyma, located in the striatum (and pallidum), dentatum and cortex. Wilson's disease, generally designated as "bilateral progressive lenticular degeneration," commonly presents a necrosis of the parenchyma combined with a formation of fat globular cells, whereas the atypical large glia cells of Alzheimer may be wanting. The pseudosclerotic process in this location, on the other hand, is commonly characterized by the occurrence of Alzheimer's large atypical glia cells, together with grave degenerative phenomena in the ganglion cells, but without a necrosis of the parenchyma, no fat granular-cell formation and no formation of the vacuoles and glia fibers.

The atypical large glia cells of Alzheimer, in my opinion and in keeping with my anatomic experience, do not show the evidence of embryonic appearance, but point to a peculiar acute glia reaction of a strong degenerative nature, produced by extraordinarily virulent toxins.

The etiology of both diseases and their relations to the affection of the liver and to the cerebral changes remain a mystery. The

syphilitic etiology which was present in Homen's cases must by no means be generalized, for this was wanting in almost all the cases observed subsequently. Neither can we find any verification for the theory so much discussed lately that the hepatic disease brought about cerebral changes in the striopallidary centers owing to the absence of the detoxicating function of the liver. In my laboratory we conducted careful experiments (Kirschbaum) both on human beings suffering from acute yellow atrophy of the liver and on experimental animals whose livers were damaged in various ways, but in no case could we find special affection of the basal ganglia, especially of the striopallidum.

The localization of the process in this disease is usually diffuse (striopallidum, dentatum and cortex cerebri), but we may say with certainty that the Parkinsonism in these cases is the result of the striopallidal disease.

Besides the cases mentioned, there are many atypical cases in which it is difficult to determine to which group they belong. Three years ago I described a case of a *catatonic psychosis with akinesis* of ten years' duration. The condition began between the ages of thirty and forty, and there was no familial background. Anatomically, I found the typical manifestations of Westphal-Strümpell's pseudosclerosis diffusely scattered. The cortex cerebri was the one mostly affected, then the dentatum and finally the striatum. In the white matter of the cerebrum and cerebellum many foci with fat granular cells were present.

In the literature we have 3 cases of *Wilson's disease* with a circumscribed lesion of the striopallidum—important in regard to the question of localization: The first case, described by Bielschowsky, showed clinically, akinesis, with tremor, shaking and dysarthria, resulting in a marked rigidity. Anatomically, only a pure degeneration of the striatum was found. The other 2 cases had the same localization, *i. e.*, the whole striatum and pallidum were somewhat affected, but the clinical pictures were different. The 1 case, described by von Economo, showed an outspoken rigidity with contractures, whereas the other, described by C. and O. Vogt, Bielschowsky and Thomalla, showed a torsion

spasm. The anatomic difference in these cases was only a difference in the extent of the damage of the striatum; in the case of von Economo the whole striatum was degenerated, and in the case of torsion spasm the striatum was partly affected and islands of normal structure were present.

We can conclude that purely diffuse degenerative processes of the striatum in the adult do not lead to athetosis, but to tremors shaking and dysarthria. When the striatal degeneration increase, the akinetic hypertonia becomes manifest, with a possibility of the akinesis appearing sooner than the hypertonia. The torsion spasm is like the athetosis, based on a pallidal lesion, both being dependent on the relative functional capacity of the striatum. The striatum must be at least partially intact in order that the pallidal athetoid hyperkinesis may develop.

Henschen has also described under "*spastische pseudosclerosis*" peculiar types of cases in middle age, without clear etiology, with remissions, rapid progress and the following cardinal symptoms: Beginning with anxieties, mild confusions and mild extrapyramidal symptoms, then gradually increasing in severity to a Korsakoff syndrome, with delirium, anxiety, confusion and optic and acoustic hallucinations. Besides these cortical symptoms there are pyramidal tract symptoms, such as absence of abdominal reflexes, and occasional Babinski and Oppenheim signs but no marked paralysis. Of special note are the extrapyramidal symptoms in the form of tremor and shaking, increased tension in the extremities, akinesis, dysarthria, astasia-abasia and frequently marked pains. This condition terminates fatally in about one to three years, frequently with signs of irritability and paralysis of bulbar centers and marked mental deterioration. Macroscopically, a slight atrophy of the cerebral cortex and of the striatum is usually found. Histologically, the characteristic process is a progressive parenchymatous degeneration in certain areas of the gray matter. It consists of fatty degeneration of the ganglion and glia cells without fat granular cells. There is irregular ganglion cell degeneration, often with glia roset formation; later, diffuse protoplasmatic glia proliferation and lighter glia-fiber production occur.

In the severest cases the condition terminates in a status spongiosus, with small microscopic vacuoles in the affected areas. Occasionally perivascular infiltrations are encountered.

The severest damage is seen in the cortex of the frontal lobes, in the centralis anterior, with more or less damage to the other cortical areas. The degeneration of the lamina granularis interna and of the three lower layers is especially apparent. Betz's pyramidal cells are completely destroyed. The striatum shows the same changes as the lower cortical layers, as do certain nuclei of the thalamus. Milder changes are found in the substantia nigra and pons and sometimes in the medulla oblongata or spinalis. Of the projection fibers, only the pyramidal tracts appear to be somewhat lighter stained.

The symptomatology may vary greatly; in the beginning it may be mistaken for neurasthenia and multiple sclerosis, and in the terminal state it may stimulate general paralysis or Alzheimer's disease.

The histologic process corresponds in many ways to metencephalitis. It is still an open question whether these histologically similar cases form a uniform etiologic-nosologic entity.

I have therefore put them into one group under "spastic pseudosclerosis" of uncertain etiology. Similar symptomatology is to be found in Wilson's disease and in cases with arteriosclerotic or syphilitic bloodvessel degeneration. The differential diagnosis is given anatomically by the type of the histologic process and clinically by the absence of certain signs that indicate Wilson's disease or bloodvessel changes.

In cases of cerebral arteriosclerosis we frequently see combinations of partial pyramidal tract and extrapyramidal lesions, even in relatively early senescence. Anatomically, we find multiple small arteriosclerotic foci in the gray or white matter of the centralis anterior, in addition to similar lesions in the striopallidum, thalamus or in the frontoparietocerebellar system.

The Athetoses. The athetoses can be classified thus: (1) Athetosis symptomatica (in cases of Wilson's disease, arteriosclerosis or syphilis cerebri, metencephalitis, etc.), (2) athetosis of early

childhood and (3) athetosis of adolescence. I have demonstrated in the foregoing that torsion spasm is based on a focal pallidal lesion, and in the same sense also symptomatic athetosis has a pallidal localization. I can illustrate with the case of a patient with syphilitic muscular rigidity with an apoplectiform athetosis of the left arm. The striopallidum had small arteriosclerotic foci on both sides, but in the arm region of the right side the pallidum showed a large lesion which had produced the athetosis of the left arm. Another patient with the same disease suddenly developed an athetosis of the lower extremities, with a marked tendency to twisting movements in addition to the common signs of the arteriosclerotic muscle rigidity in the striopallidum; the pallidum, especially the ansa lenticularis, showed large foci in the pars posterior on both sides in the region for the lower extremity. The following case is of special interest and importance: A patient at first had arteriosclerotic muscle rigidity, then an apoplectiform conjugate deviation to the right, flaccid paralysis on the right side and in addition an athetosis in the left arm—of six days' duration. Anatomically, I found an evident status cribratus arterioscleroticus in the striopallidum of both sides, in addition to which there was a recent large hemorrhage in the striopallidum on the left and an old focus in the pars anterior pallidi of the right side. In my opinion, the athetosis was the result of the old focal pallidal lesion and the flaccid paralysis the result of the fresh lesion of the striopallidum. Thus we see that an old pallidal focus may be incited to an athetosis in the contralateral side by a fresh lesion in the striopallidum of the other side.

The innervation of the striatum and pallidum is mostly contralateral, but, to a lesser degree, also homolateral. This bilateral innervation explains how striopallidal damage of one side may be adjusted to a great extent, as well as the importance of special pallidal functional balance of both sides in the development of the extrapyramidal disturbances.

My findings show conclusively that *athetoid movements in the adult are found only in cases in which there are lesions in the palli-*

dum. If such apoplectiform lesions in the pallidum enlarge or multiply, however, the athetosis ceases, and rigidity sets in. *Like the striatum, the pallidum has a somatotopical localization corresponding to the various regions of the body.* The area representing the head lies orally, then follows that of the upper extremity, then that of the trunk and finally that of the lower extremity.

Next, we have to consider *athetosis occurring in earliest infancy* and forming a part of Little's disease. This condition is congenital, and manifests itself in epileptic seizures, rigidity and athetosis, frequently showing a tendency to improvement. Psychic symptoms may be absent. Anatomically, we find the "status marmoratus" (C. and O. Vogt) of the striatum, which is a peculiar myelin fiber picture in the striatum and is the result of disturbance in development. It is the only affection of the striatum which produces pure athetosis.

Furthermore, we have athetosis in cases of infantile cerebral palsy. In such cases we find the Bielschowsky type of cerebral hemiatrophy with a degeneration of the third layer of the centralis anterior, in addition to a mild affection of the striatum, so that in these cases the athetosis was due to degeneration in both the striatum and laminæ centralis anterior.

The question as to what constitutes, clinically and anatomically, the *infantile cerebral palsies* is as yet not settled. We can consider, however, as the main group that clinico-anatomic entity which is characterized in its syndrome by the typical triad of spastic hemiplegia, feeblemindedness and epilepsy, even though the causes are not always the same. Its anatomic characteristic features are, as a rule, unilateral cerebral defects along the distribution of the middle cerebral artery and the formation of external and internal cavities with marked distortion in the adjacent cortex.

This group of cases of varying etiology must be differentiated from other series of cases similar in symptomatology but clinically and anatomically different.

This series consists of:

1. Malformations of the brain (macrogyria, microgyria, etc.), congenital hydrocephalus, tumors (especially plexus and ventricle tumors), syringobulbia, diffuse sclerosis of the white matter in childhood, and such etiologic or nosologic entities as multiple sclerosis in childhood, juvenile paralysis, tuberous sclerosis, as well as such familiar diseases as Merzbacher-Pelizaeus disease or infantile and juvenile amaurotic idiocy.

2. All outspoken striopallidal Little's disease, athetoses or rigidities. This group also includes the status marmoratus of the striatum, the status dysmyelinisatus of the pallidum of C. and O. Vogt (athetosis, terminating in rigidity), Little's rigidity due to congenital syphilis, infantile Parkinsonism following epidemic encephalitis, and in Wilson's disease as well as the torsion-dystonia, double athetosis and infantile chorea, occurring especially in pathologic processes affecting the basal ganglia.

In contradistinction to the last series the group of infantile cerebral palsy first mentioned shows a characteristic pathologic process. The insult which affects the brain during normal intra-uterine or extra-uterine development brings about a lesion in the cerebrum, preferably in certain cortical areas (such as the area along the distribution of the middle cerebral artery), resulting in a total or partial melting away of tissue, with subsequent scar formation. The otherwise normally constituted and developed hemisphere segments become involved in a more or less extensive cicatricial shrinking, whereby the vascularity and the exogenic etiologic factors are usually clearly emphasized, whereas the adjacent tissues become the seat of prominent secondary phenomena (such as extensive vacuole formation in the cortex and white matter, degeneration of certain layers in the cortex, etc.). The number of primary lesions, their distribution and the presence and size of the macroscopically visible vacuoles are, of course, important in determining the syndrome in individual cases, but for purposes of classification they are only of secondary importance. The anatomic factor common to all these cases is the scar formation in cerebral areas, mostly in the cortical

zones, in relation to the bloodvessel distribution. The main group of infantile cerebral palsy which is characterized by feeblemindedness, epilepsy and motor paralysis together with the corresponding lesions localized along the distribution of the middle cerebral artery, shows at times, a tendency to disappearance of either the motor or psychic symptoms. So we see in some cases a gradual disappearance of the imbecility and the epilepsy, but the retention of the motor symptoms (the "singular left-handed," stuttering); whereas in other psychic symptoms (mental deficiency) remain, with a gradual disappearance of the motor paralyses and the epileptic attacks (paradoxal infantile cerebral palsy of Freud).

Clinically and anatomically considered, the group lends itself to the following classification:

A. Symptomatic classification:

1. Infantile cerebral palsy with motor paralyses.
   - (*a*) Slight motor paralysis.
   - (*b*) Motorspastic paralysis with athetosis (Bielschowsky's cerebral hemiatrophy with degeneration of the striatum) plus feeblemindedness and epilepsy.
   - (*c*) Cases with grave spastic motor paralysis, feeblemindedness and epilepsy (the main and typical group).
2. Infantile cerebral palsy without outspoken motor paralyses (paradoxical forms).
   - (*a*) Epilepsy and feeblemindedness with indications of spastic manifestations, *e. g.*, only a Babinski sign.
   - (*b*) Feeblemindedness with epilepsy and ultimate speech disturbances.
   - (*c*) Feeblemindedness with psychic epilepsy (epileptiform attacks of excitement).
   - (*d*) Cases with other lesions (blindness, deafness, ataxia, etc.) and corresponding lesions in silent regions of the brain.

B. Classification according to the occurrence of the insult and the etiologic factor.

1. Intra-uterine.
2. Traumas occurring during labor.
3. Extra-uterine.

In the last (3) especially, three important etiologic factors have to be considered:

1. Strümpell's polio-encephalitis (probably related to the virus of anterior poliomyelitis).
2. Various infectious diseases (scarlatina, typhus, syphilis and other conditions).
3. Trauma.

In addition to the foregoing, the *generalized bilateral athetoses* of childhood and adolescence have been present in all cases thus far described of disease of the pallidum. The localization in most of these cases was of a diffuse character, but the pallidum was partly involved in all. This is also illustrated by cases seen in Spiller's and Winkelman's Laboratories. The slides were shown by the authors during my sojourn in Philadelphia. In this group should also be included the status dysmyelinisatus of the pallidum (C. and O. Vogt), with the clinical picture of athetosis terminating in rigidity, as well as the cases of O. Fischer and Rothmann, Richter, Hallervorden and Spatz, which showed peculiar changes in the pallidum. As further etiologic factors, the familiar constitutional factor is emphasized in the cases of Hallervorden and Spatz; in other cases asphyxia at birth probably played a significant rôle.

We know that the pallidum has a special relationship (physico-chemical) to certain poisons, especially carbon dioxide and manganese. In the cases of *carbon dioxide intoxication* we find almost always a degeneration or necrosis of the pallidum. Of special importance and interest in this respect is the case described by Helene Deutsch, in which a bilateral necrosis of the nucleus lenticularis was found following an attempt at strangulation. Clinically, the case showed only a marked rigidity with contractures in the terminal state.

In a *unilateral lesion of the corpus Luysi* there occurs a pronounced hemiballismus. I had a case of arteriosclerotic muscular rigidity following several apoplectiform insults. Two weeks prior to death a left-sided flaccid hemiparalysis appeared suddenly, followed the next day by a hemiballismus on the same side. Anatomically, I found the typical changes in the striopallidum on both sides accounting for the rigidity, and in addition a quite fresh lesion clearly and strictly localized in the right corpus Luysi. Similar cases are described by von Economo and O. Fischer.

A striopallidal Parkinsonismus, when complicated by foci in the thalamus, especially in the lateral portion, will exhibit symptoms of flaccid paralysis with marked paresthesias, frequently astasia, abasia and eventually sleep disturbances. When the thalamic paralysis improves, the Parkinsonian symptoms, together with a tremor, may return to some extent in the paralytic limbs.

At this point I wish to cite a rare and interesting case—that of "a child without a telencephalon." It was born after a difficult and prolonged labor. Clinically, there was a marked and complete rigidity, and the child was capable of sucking, swallowing and faint crying; it lived only nine months. Anatomically, I found the whole cortex and myelin layer of the brain completely degenerated, only a part of the temporal lobe being fairly normal. The striatum was partly involved, whereas the whole pallidum, with the thalamus, cerebellum, midbrain and brain stem were normal.

Clinically and anatomically, this case was similar to the case described by Edinger and Fischer, in which the patient lived for three years. In both cases there was marked rigidity of pallidal form in spite of the fact that the striatum was only slightly affected. This picture is one of decerebrate rigidity of Sherrington. The literature contains descriptions of similar cases of marked pallidal rigidity in infants and in adults in whom only both lenticular nuclei were affected.

Thus we see that in man the striopallidum is of the greatest importance in the development and coördination of movement

in the infant as well as in the adult. This is contrary to experimental findings in animals, especially in animals without a telencephalon or thalamus. All these animals do not show decerebrate rigidity and can execute perfectly complicated movements, in spite of the absence of the whole cortex and of the striopallidum. Furthermore, they show normal tonus, can run, jump and climb, can change postures and can chew and swallow. The decerebrate rigidity appears only after injury to the red nucleus.

In man, however, these centers acquire great functional importance, so that the new-born infant depends entirely on a properly balanced activity of the neëncephalon with the striopallidum, which assures undisturbed function for the red nucleus and brain stem. These experiences show the dangers of applying the criteria of animal experimentation to man in some cases.

These significant differences between animals and human beings may be due to various causes. Magnus believes that the changes in the red nucleus and brain stem in these conditions in man have not been sufficiently stressed. This does not coincide with my findings.

Of all the various explanations of this phenomenon, the following seems to me to be the most plausible.

We must assume that in human beings there has occurred an important displacement of functional activity in favor of our extrapyramidal system. Thus with the higher development of the cerebral cortex there has also been a greater functional differentiation in those areas, especially the striatum and dorsal thalamus, although they originated from the same matrix (alar plate of the prosencephalon). Even though the former, as C. and O. Vogt point out, including the pallidum, has not essentially undergone any higher anatomic development in comparison with the more highly developed monkeys, we must assume in man a higher functional differentiation, especially in the specific human functions (more highly developed gestures of reactions and expression, facial expression, speech, the upright gait, etc.). Special anatomic evidences are furnished us by the substantia nigra in human beings, in whom this structure has doubtless evolved more power-

fully and with greater differentiation than in the highest mammals, and is characterized by the occurrence of ganglion cells containing melanin. As the latter shows this melanin first in the third or fourth year of life, the development of this gray nucleus offers a striking parallel to the physiologic differentiation of infantile movements in the acts of standing, walking and speaking. The facts of human pathology speak clearly for a similar displacement (change) in the functional significance of the other extrapyramidal centers.

A review of the individual clinical syndromes and their anatomic localization leads us to the following conclusions:

Disturbances of the Striatum. Disturbances of the striatum may manifest themselves in the following clinical syndromes: 1. Mild paresis of voluntary and involuntary movements; the synergic movements suffer most, while the isolated movements of individual members remain intact.

2. Incoördination of synergic actions, especially sitting, standing, walking, speaking and all bulbar functions (striatal pseudobulbar palsy).

3. Akinesias.

4. Tremor and shaking; hypertonia and mobile rigidity.

5. Absence of reflex abnormality, sensibility and psychic disturbances

6. In the adult a striatal degeneration (especially of the small cells) constitutes the choreic syndrome with a mild form of akinesis and hypotonia.

7. Milder affections of the striatum produce parakineses, the severity depending on the extent of the damage.

8. A slow destruction of the large ganglion cells of the striatum or of the whole striatum produces rigidity which in the diffuse processes is marked.

9. Large apoplectiform lesions of the striatum produce contralateral flaccid paralysis which may frequently regress and lead to rigidity (the striatum, as stated, having bilateral action) more marked on the contralateral side.

10. In the infantile as yet undeveloped brain, pure striatal lesions produce athetosis with hypertonia.

The pallidum syndrome consists of: 1. Focal lesions—of athetosis and torsion spasm with rigidity (contralateral to the affected side) and often limited to the individual limb, according to the localization.

2. Diffuse, but partial lesions of the pallidum produce general athetosis with a mobile rigidity. Diffuse complete lesions produce marked rigidity, followed by contractures.

3. Absence of reflex anomalies, sensibility and psychic disturbances, and absence of vasomotor and temperature disturbances.

Lesions in the corpus Luysi produce hemiballismus. Lesions in the substantia nigra (especially in the zona compacta) produce rigidity of the Parkinsonian type.

We must now turn to a brief discussion of an important question, namely, as to where *the real basis for all our extrapyramidal motor disturbances* is located.

We know that lesions in certain parts of the thalamus can give rise to choreiform movements, and we can, therefore, say that these disturbances are due to some change in the striopallidal functions brought about in an indirect fashion. But then disturbances of an extrapyramidal type are also found in cases in which there are lesions in the dentatum-rubral tract (Bonhöffer), and even in cases of Wernicke's poliencephalitis hemorrhagica superior. I had an opportunity to study such a case in my laboratory.

The rationale for locating all these motor disturbances in the midbrain and brain stem is furnished by a case described by Schilder in 1911. I would offer the following pathophysiologic explanation in this instance: The case was that of a man who for a long time had a spastic hemiparalysis in the right side and then suddenly developed marked athetosis on the paralytic side, which persisted for three weeks and terminated in death. Anatomically, Schilder found an old scar in the whole striopallidum and capsula interna of the left side, with secondary degeneration in the corpus Luysi and pes pedunculi and a recent focus in the right dentatum with a partial damage of this gray nucleus. The athetosis was the result of the focus in the dentatum, and the

basis for the motor disturbance therefore could not be in the striopallidum which had been entirely degenerated for a long time, but must have been in the midbrain and brain stem. The midbrain and brain stem centers are subject to a double influence. In the first place, they are influenced by the efferent tracts of the cerebellum, and second, directly through the extrapyramidal system, especially by the fibers to the red nucleus and to the commissura posterior, whereby both pallida exert homolateral and contralateral influences. Thus numerous influences are brought to bear on the mechanism of the brain stem, whereby the maintenance of its functional balance is assured. If this balance should be disturbed at any point incoördination of the brain stem function may develop. This produces a disruption of the extrapyramidally influenced automatism, the function of which is performed by these lower centers.

The harmonious coöperation of these systems assures the normal function of the brain stem mechanism, so that disturbances in function may be noted, definitely, only under certain conditions, whereas in other instances they are compensated for by the adjustment of other systems, and appear only in mild form or not at all.

When the whole striopallidum and dentatum of both sides are degenerated the result is an extremely marked akinetic rigidity, taking the form of Sherrington's decerebrate rigidity. I have had the opportunity to examine such a case.

If we are to utilize all these anatomic, physiologic and pathologic facts for the purpose of constructing a picture of the physiology of the extrapyramidal system we can state the following:

We have in the dorsal part of the midbrain and brain stem an important motor coördinating apparatus, which as the result of being stimulated proprioceptively is the basis for all tone, station and posture. The red nucleus is the oral hypertrophy of this apparatus. In agreement with Magnus, we may consider the coöperation of the spinal reflexes, brain stem and red nucleus reflexes in the distribution of tonus in standing and in posture somewhat as follows:

The spinal cord centers for an extremity are reflexly stimulated through the posterior roots entering at the same level corresponding to the flexion and extension centers. To this level descends a tract from the centers in the posterior portion of the brain stem, which would bring about a decerebrate rigidity if it were the only agent acting on the spinal cord. This tract would, therefore, displace the tonus distribution in the spinal cord in favor of the extensor muscles. But, if together with this, impulses should come from the red nucleus through the rubrospinal tract to the same spinal cord segment, the tonus distribution would be displaced rather toward the flexor muscles. To a certain extent, the spinal cord centers are subject to two restraining forces—one having to do with extension and influenced by the medulla oblongata and one having to do with flexion and influenced by the red nucleus.

The resultant of these two influences is a uniform tonus distribution in the innervated organs. In addition there are fibers from the pyramidal tracts which end in the same segment of the spinal cord and carry chiefly impulses making for flexion, as experiments on cerebral stimulation show.

Systems Influencing Motor Apparatus of Midbrain and Brain Stem. This motor apparatus of the midbrain and brain stem, especially the red nucleus, is influenced and stabilized by two systems:

1. *The Cerebellum.* The chief function of this proprioceptively stimulated organ is to intensify, to give position and to inhibit the whole coördinating apparatus, and more especially in the matter of controlling specifically those locomotor synergies which are determined by the direction of the movements or the falling of the body and its parts.

2. *Our Principal Extrapyramidal System and its Individual Centers.* This system is built up as a whole on the coördinating mechanism of the brain stem and cerebellum, which it employs as a firm basis. The whole of this system, with the exception of the substantia nigra (which also derives direct cortical fibers), derives its stimuli from the thalamus and hypothalamus. The

hypothalamic basis of the diencephalon seems to us to be of great significance in connection with the central regulations of all the metabolic processes of the organism, and more especially of muscle tone. The thalamus serves as a large reservoir afferently and efferently connected with the entire cortex, and receives proprioceptive and, especially, exteroceptive and cerebellar impulses, all of which bring to it information concerning the position of the body as well as the state of tonus of the total musculature and the deeper unconscious sensations. The thalamus is therefore an organ which not only orients the individual as to the changes in the state and tonus of his body, but also puts him in intimate relation with the outer world, this being of considerable significance for the sensations, feelings and emotions and, in a certain sense, also for the faculty of attention, for psychic activity and for consciousness as a whole.

Our extrapyramidal system—as the efferent organ of the thalamus and hypothalamus, in which the incoming stimuli are translated into highly developed motor phenomena by virtue of the specific activity of these centers—thus appears to be a center for the movements of expression, the reactive flight and defence actions, the pain-protection and fright reflexes, automatic change of position and attitudes, assisting movements employed in locomotion, compulsive associated movements and the motor-partial components, which play a rôle in the actions of sitting, walking, standing, chewing, swallowing and speaking. It also exerts a regulating influence on the vegetative, hypothalmic centers which preside over the chemicophysical tonic processes, and is an organ for tone. It should be finally regarded as a part of the voluntary tract through which cortical impulses are directed on the anterior horn.

Hypokinetic and akinetic phenomena are to be attributed to a diminution of innervation due to the lack of stimulation from the extrapyramidal system and of discharges from its centers. The rigid components in the partial phenomena are based on the loss of the regulating function of the hypothalmic centers, the motor apparatus of the midbrain and brain stem and of the cerebellar

(Sicherung—stabilizing) protection through the extrapyramidal system.

Chorea is to be regarded as an ataxia of pallidal functions conditioned by the striatum, especially by the omission of the small receptive and associative ganglion cell elements of the striatum. A tic is to be regarded similarly, but in this case circumscribed muscle areas in the striatum only are affected.

Complicated parakinesias are akin to choreiform phenomena and are to be attributed to a similar mechanism, but in these cases a milder damage to the striatum must be the main pathogenic factor. The more systemically the small cell degeneration in the striatum proceeds, the purer will be the choreiform character of the peculiar movements. Tremor and shaking seem to be, in part at least, determined by the striatum, being ataxic disturbances of coördination of the pallidary and subpallidary centers (perhaps also as peripheral mechanisms of muscle innervation) wherein the injury to the large and small striatum cells of the contralateral side is the important factor. Similarly, the relative injury of the striatum on the one side and of the pallidum on the other also plays an important rôle. Tremors and pulsions are also to be found almost exclusively in condition of the substantia nigra, and are evidently expressions of tone disturbances.

Congenital athetoses of early childhood are to be attributed in the corresponding diseases to the abolition of the regulating function which the striatum exerts on the pallidum, caused by pathologic processes in the striatum. In such cases of athetosis, incoordinate and distorted mass movements similar to the mass movements of earliest childhood occur.

The athetoses of later childhood, early adolescence and adult life are to be regarded, together with torsion spasm, as ataxic disturbances of coördination having a pallidal origin (disturbance of pallidary function), in which the interferences with the static and kinetic coördinating mechanism in the midbrain and brain stem are particularly prominent. In contrast to the athetoses of adults, which depend on focal pallidary lesions, the generalized athetoses of later childhood and adolescence, corresponding to

the diffuse pallidary degeneration, show a preponderance of subpallidary mass movements and mechanisms of the brain stem.

The chorea-athetotic phenomena which appear in connection with diseases of the region of the red nucleus, of the brachium conjunctinum (Bindearm) and of the tegmentum mesencephali (Hirnschenkelhaube) are ultimately to be referred to the brain stem and to be attributed to the release of the midbrain (red nucleus) and brain stem from cerebellar control (Sicherung) on the one hand and pallidary control (Sicherung) on the other.

It is important to distinguish these diseases from those that are produced by lesions located on the oral side of the red nucleus, where the hyperkinesias are to be regarded as indirectly caused by failure of striopallidal functioning in the sense of ataxic disturbances; the akinesias then seem to be flaccid paralyses of the striopallidum.

Functions of Single Centers. On the basis of anatomic considerations and of lack of function in correctly localized pathologic processes, we may at present express the following views concerning the *functions of the single centers:*

The *striatum* is the true center for gestures of expression, reactive movements, etc. It also gives tone to the pallidum. The *pallidum,* which in the new-born is the center for the primitive and incoördinated automatic movements of earliest childhood become in the adult the center for locomotor synergies of single muscle areas and portions of the extremities in the service of striate locomotor automatic acts, which are built on the locomotor synergies of the cerebellum and brain stem. In addition, it also exerts a significant influence in regulating tone.

The *corpus Luysi* apparently contrasts the locomotor synergies of whole sections of the body, with especial emphasis on cerebellar balancing components.

The *substantia nigra* is to be regarded especially as a tone controlling center, which in a special way serves to determine the succession of movements.

The striatum and pallidum are somatotopically linked and, like the corpus Luysi, innervate both halves of the body, but with

special emphasis on the opposite half. Similar relations clearly apply also to the substantia nigra.

Finally, I should like to emphasize that *the whole extrapyramidal system is functioning when the thalamus is active, and as a result the pyramidal system has the most favorable condition for its own functioning, so that anterior horn cells are constantly receiving normally directing impulses through the working of the extrapyramidal system.*

Psychoneuroses in Relation to General Medicine

BY ALFRED GORDON, M.D.

In order to understand the relation of psychoneurotic manifestations to clinical medicine in all its ramifications, one must endeavor first of all to form a clear conception of the underlying factors capable of producing functional disturbances in the domain of the nervous system. Not infrequently it happens, as we all know, that when an individual develops for any reason at all, subjective disturbances referable to the ear, nasopharynx or larynx the otolaryngologist is consulted first. Should the subjective disturbances have an apparent relationship to the function of the ovaries, or to that of the vesical and biliary organs or of other abdominal viscera, to the function of respiratory and cardiac organs, to the function of the eyes—in all such cases the respective medical or surgical worker will be consulted first. Such an attitude on the part of the lay patient is psychologically logical and correct. But from a medical standpoint, as we know, the above attitude not infrequently leads to serious errors. That is to say, there are disturbances which have no fundamentally serious relationship to any given abdominal or thoracic viscera but belong to purely mental functions which, for reasons of a psychic character, dissociated the work of various elements which enter in formation of harmonious display of organs and tissues. What precisely characterizes the individual in all such cases is not the

multiplicity of symptoms, not the innumerable functional disorders which may simulate organic diseases, not the painful sensations which he or she experiences, but only a special state of mind —a special mentality.

Human machinery is so complex in its various operations that every one of us, otherwise sound, experiences now and then some indication of a functional disorder: Either there is a gastric manifestation, or a vague pain, or a cardiac palpitation, or a fugacious neuralgic discomfort. But being normally constituted we give all such symptoms their proper interpretation—our attention is not firmly arrested on them as we continue our activities in spite of them. Furthermore, we are able to overcome unpleasant circumstances which may arise at any time; we may even surmount obstacles of a most serious nature. Our relative indifference to all such conditions constitutes a normal state of mental health.

On the other hand the individuals whose attention is held firmly and for a prolonged period of time by those subjective disturbances enumerated above, who view the least unpleasant event as a catastrophe, who develop obsessive ideas and hold on to them for months and years, whose association of ideas is such that fears, anxiety and abnormal inhibitive or abulic phenomena make their appearance with the greatest facility, and, *à propos* of insignificant occurrences, whose suggestibility and autosuggestibility are exaggerated, whose reactions to external or internal stimuli are intense, all such personalities present a type apart, an abnormal type of humanity, and therefore require special consideration.

Some fuller elaboration of this category of individuals is now indicated for a clearer understanding of the subject under discussion. First of all, psychoneuroses should be firmly distinguished from mental deficiency. The latter is usually congenital and inherent, and is the direct result of a morphological or physiological abnormality of the nervous structure. Of course, psychoneurotic manifestations may appear in mentally defective individuals, but there is no unusual relationship between the two, and we are considering here only intellectually normal cases. Psychoneuroses

are fundamentally psychogenic and develop in the midst and because of abnormal psychological experiences. Before discussing these experiences let us present a few examples of psychoneurotic manifestations. One female patient, aged twenty-eight years, following a normal confinement with no undue loss of blood and with a prompt recovery, misinterpreted her very slight serious vaginal discharges which she explained to herself as due to a serious affection of her genitalia. Otherwise perfectly sound, she consulted a number of gynecologists, who treated her by various methods, and two of whom performed curetting. The woman became very much depressed; she felt very unhappy and was in constant fear of malignancy, without an actual physical constitutional basis for it. Subsequent events proved that her belief was only psychogenic, as she made a complete recovery under a psychotherapeutic management.

A young married woman, aged twenty-five years, was suffering from chronic constipation. She would occasionally have headache. Coming frequently in contact with a female friend who also had headache and who attempted to commit suicide in a fit of jealousy of her husband, my patient developed an idea that her friend became insane because of the pain in the head, and that therefore her own headache might in the future lead to the same consequences. She was in constant fear of such a termination. She was advised to consult an oculist, who promptly refracted her eyes and told her that the proper glasses would cure the condition. For two years she was in a state of fear and anxiety without any relief. She consulted a gynecologist, also a general surgeon, at different periods. The former curetted the uterus, the second operated for suspected adhesions of the transverse colon. Neither the glasses, nor the curettement, nor the operation on the colon removed the original mental condition, although every one of the three men assured her that the removal of the condition, which they considered respectively as the sole morbid cause, would undoubtedly bring about a complete cure. Under psychotherapeutic measures during a short period of time the fear and anxiety as well as the slight headache have all disappeared.

A young man, aged twenty-five years, during a period of three years, complained of disturbances referable to almost every organ in his body. At first it was the heart, then the gall-bladder, then the nasal cavities, the ears, the eyes, the genitalia, rectum and finally the right hypochondrium. Numerous physicians in and outside of hospitals were consulted and every one advised and actually performed some manipulations or small operations. Some of them advised gross abdominal operations. For the last of his multiple complaints a surgeon advised an appendectomy. Accordingly the patient was placed on the operating-table. While the preliminary preparations were being made, namely, the assortment of the instruments, washing the hands of those who were to participate in the operation, etc., the patient was suddenly seized with fright, refused to be operated on and at once left the hospital. Since then there has been no return of pain in the right hypochondrium. Toward the end of his peregrinations he observed a slight cloudiness of his urine. At once he conceived the idea of a kidney affection. Again he consulted several internists, each of whom made a different diagnosis. It is at that time that the writer had a good opportunity to see and keep him under observation. It must be mentioned at this juncture that during the entire illness of several years' duration the patient continued uninterruptedly his usual occupation, namely, that of a railroad conductor. He always slept well and had a voracious appetite.

At the time of the examination there was no doubt in my mind as to the psychogenic origin of all the complaints of the patient. Psychotherapeutic management alone succeeded in removing the last obsessive ideas. He is well at present, but since such disorders are episodic in character, the probabilities are that new hypochondriacal manifestations will eventually make their appearance when confronted with new emotional factors, the nature of which will be discussed below.

A girl, aged seventeen years, developed abulic phenomena. If while crossing a street she would notice a loose brick, on the ground, she would be seized with fear and a state of extreme anxiety; she could not and would not step over the object, but go

around it and continue her gait. When, however, she would make an effort to overcome her deficient will-power, she would tremble, cry and stop. Being slender and pale, and having irregular and scanty menstruation, she was taken first of all to a gynecologist, whose diagnosis was anteversion of the uterus, and that the latter was the direct cause of her psychoneurosis. He urged an operation. A general surgeon consulted subsequently spoke of uterine adhesions and advised some surgical procedures, the nature of which I could not determine. A laparotomy was performed, with the result of a decided intensification of her psychic condition as well as of her menstrual difficulties.

Examples such as the few related could be multiplied, but they are sufficient to demonstrate that besides a physical there is also a psychological approach which after all may be the most important if not the only method in managing psychoneuroses. An organic or structural lesion can no more be viewed as the sole basis of functional psychic disorders. In order to know how to manage these peculiar phenomena, let us briefly consider their nature and their meaning.

The behavior of every indidivual is the result of an interrelation of several elements, namely, emotional instinctive tendencies—such as fear, anger, self-assertion, attachment, etc.—also the environmental conditions. The instinctive tendencies will have a different coloring in different individuals according to inherited qualifications, that is to say, a highly or less sensitive person will manifest his or her emotional elements in different ways. The constant interaction between these instinctive emotions and environmental objects or occurrences produces complex psychological states or complexes. We live, therefore, in the midst of daily or hourly conflicts between the inherent and exterior elements. Complexes are being created continually. When they are recognized by the individual self the conscious ego is able to overcome them and the normal state is maintained and not disturbed. Many complexes, however, are not recognized, and since all complexes are different from each other and have a different aim and purpose, antagonism of one to another is constantly being created.

As they are not recognized, as the conscious ego has no control over them, they may remain with us an indefinite time and are apt to create functional nervous disorders or psychoneuroses. In fixed ideas, obsessions, fears, states of anxiety, abulias, etc., in all such cases as we have seen from the histories of the few patients cited above, the physical symptoms alone emerge, such as pain in the hypochondrium simulating appendicitis, pain in the cardiac or pulmonary region simulating a disease of the heart or lung, etc.; but the emotion associated with the fixed ideas remains, and as long as the latter is unaltered or not removed the physical manifestation remains and the patient will continue being unhappy and a sufferer.

The various physical manifestations of psychoneuroses may be relieved and the individual may find with an effort on his part a certain skill in adapting himself to his environment and become more or less contented for the time being. But such a situation is not a cure, because the essential element in the conflict of various complexes has not been attacked, namely, the emotional instinctive factor, which plays the most important rôle in the psychoneurosis. It is not only the adaptation to the environment, but also and more emphatically the adaptation to one's self that is important. Otherwise speaking, a psychoneurosis can be removed only when the sufferer is shown how to unravel and lay bare the elements of the complexes which are in constant conflict so that to fit him to face himself. Attempts to remove physical discomfort will not remove the emotional elements which have created the psychic discomfort and which the patient will continue carrying with him indefinitely. The inability of understanding this essential principle and the want of desire of considering a psychological end in human suffering besides a purely biological end are the cause of failure of treatment. Therein lies the reason of the fact that very frequently the cause of psychoneurotic disorders is sought elsewhere: in the uterus, ovaries or in the genitalia in general. Next in order is the digestive apparatus that is not infrequently incriminated. Dilatation of the stomach, gastroptosis, enteroptosis, nephroptosis, and cholecystitis are all condi-

tions that are thought of and major operations are being performed. Not only is there total therapeutic failure as far as the patient's complaints are concerned, but undesirable local and general consequences may arise which will render the operated individual organically unfit in addition to his psychic unhappiness. As one of many examples of this particular contention I may call attention to the damage produced by castration in women. In 1914, in a paper read before the American Medical Association, lxviii, 1345, the medical histories of 112 women who underwent complete or partial removal of the uterus or ovaries or of both were presented and very extensively discussed from the broadest standpoint by internists, general surgeons, gynecologists and neurologists. It was shown that the preëxisting nervous and psychic phenomena, for which the operations were undertaken, became aggravated in the weeks and the months following the operations. The obsessions and other psychoneuroses from which several women suffered prior to the oöphorectomies became since then more persistent and covered a larger field of morbid ideas than heretofore. Those who suffered from the hysterical paroxysms began to have them in a more accentuated form and more frequently. Former hypochondriacal and anxiety states became deeper. All such cases were referred to the gynecologists, with indiscriminate assurances that their vague nervous manifestations were exclusively due to indefinite gynecological conditions. Of course, the operations were uniformly successful, but the victims' existences were rendered most unfortunate and distressing. It was evident that partial or complete hystero-oöphorectomies disturbed the well-established physiological effect of ovarian tissue on the economy or perhaps disturbed the intimate relationship between various ductless glands which as we have some reasons to believe exists. At all events, in addition to the preëxisting pyschic phenomena additional disturbances were thus created.

The foregoing observations are sufficiently illustrative to contend that the real cause of psychoneurotic phenomena does not lie in accidental occurrences, such as traumatism, fatigue or local diseases, etc. These factors react on us all, daily and hourly, and

do not produce disorders of a permanent nature. A psychoneurotic individual, on the contrary, reacts differently because of his special make-up, of his special mental characteristics. The latter render him highly suggestible, highly sensitive and highly emotional. While they do not present new phenomena which are not observed in normal individuals, their reactions, however, to all kinds of stimuli is expressed in a greater intensity and are reproduced with a greater facility and branch out in a most unexpected manner. The complexes which were described above and which we considered as the result of conflicts between the instinctive emotional elements and the environment occurrences are not easily recognized, and they are not properly interpreted when recognized by psychoneurotic personalities because of their peculiar characteristics. The complexes which arise in them are more numerous, more antagonistic to each other because of the greater intensity of each emotional element which enters into the formation of the complexes. The environmental factors which also form a part of the complexes equally give a different sensorial impression in the psychoneurotics and consequently the mental representation in the latter will correspondingly be different from that of normal individuals.

The methods employed in the management of psychoneuroses are several. The object of the present thesis is not the discussion of methods or procedures in bringing to the surface the *modus operandi* of the complexes which are the basis of psychoneurotic phenomena. My sole purpose is to call attention to the fact that all these abnormal manifestations are too psychic in character, that the functional disorders of which the victims complain are too much dependent upon special mental attitudes to be attributed exclusively to organic disorders of tissues and organs. Psychoneurotics are psychopathic individuals. They occupy a place between insane and normal. Their number is legion and their multiple manifestations present infinite varieties and subvarieties. The latter are intermingled and mixed with human suffering in all its forms and degrees, medical as well as surgical.

In dealing with human life it behooves us medical men to

approach its phenomena not only from a purely biological but also from a psychological standpoint. The former has for object the adaptation of the individual to his environment. The latter is to have him adapted to himself. It is only after the latter task has been successfully accomplished that the individual will be fit to face his environment. No removal of tissues or organs, no artificial correction of disturbances, however accurately or skilfully they may be done, will succeed in making a psychoneurotic discard his fixed ideas, his hypochondriasis, his abulias, his fears or his obsessions if he or she is not taught properly how to restore peace amidst the bewildering complexes.

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Habit Factors in Bladder Symptoms and Pathology

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Most of the ordinary things of life are done poorly by a surprisingly large number of individuals, and it will not do to assume that such a frequently-performed act as emptying the urinary bladder is always done properly. It will require but a superficial study of the subject to reveal that at some time in life the majority of our patients develop habits in this regard which, if continued over a long period of time, would at least produce symptoms, if not true pathology. Fortunately these habits are usually of short duration and might be said to belong to the various phases of mental and physical development. So much do some of them belong to certain limited periods in life's journey that they could rather fitly be compared with the "Seven Ages of Man." However, such a strict division cannot always be made, as they occasionally become so fixed as to cover several or all of life's stages.

With such a delicately balanced mechanism as that of the

human bladder it is but natural that it should be subjected to much psychological meddling with its normal functional bent. Having both a voluntary and an involuntary rôle to fulfil, with its emptying entirely dependent upon an attitude of mind, with minds varying so greatly in poise as they do, its career is one fraught with many hazards. Of itself it is a very well-behaved viscus, but with the countless interferences of one kind or another it easily may be caused to develop habits. It is made to hold a larger quantity of fluid than it was intended to hold, or it is never allowed to become properly filled; its owner insults it by increasing his intra-abdominal pressure to force a sphincter that was intended to be opened otherwise; it is subjected to circulatory affronts of varying grades according to its owner's sex trends; it shares in the pelvic congestion of constipation and menstruation; it is far more "sinned against than sinning."

Such being so commonly the case, it is but natural that it should develop certain symptoms and that there should eventuate various pathological conditions. Strangely enough, practically no attention has been paid to these simple things, and we have been led far afield in our search for less obvious explanations and have patterned our treatment according to our commonly false etiological assumptions. We have thought of the urogenital tract and forgotten its constant mental and physical buffetings.

Increasing familiarity with the cystoscopical appearance of the bladder will reveal many slight deviations from normal which are commonly considered of no moment. A closer study of these changes will show that many of them can be placed in certain groups symptomatically, but as they are the only aberrations from a moderately fixed normal their etiology is often obscure. If, however, we view them as possible expressions of some habit it is evident that they also can be placed in readable groups, and there is developed the conviction that written in the bladder are many things that we should be able to interpret were we close enough observers.

To enlarge our knowledge of the vesical and urethral pictures, written by the patient's own habits, it will be necessary to draw

more closely the margins of what we call normal, for therein lies much vesical expression that needs interpretation. "Within normal limits" is a territory that varies in width with the powers of observation of the cystoscopist: it is an extremely fertile and interesting field for study.

In order to progress more quickly in these studies, it will be necessary for the cystoscopist to shake off a psychic condition that has greatly retarded the art. It is human to like pretty pictures, and most bladder pictures are such that they fascinate the observer. Most of those who have taught cystoscopy to physicians will agree that it is difficult to get many of them past this stage of picture fascination. They view the bladder picture as they would a beautiful painting, satisfied with the finished product as a whole and thinking nothing of how it was made. They would do best to adopt the artist's attitude in their interpretation of bladder pictures. He sees all of the stages of its production as well as the finished product.

More care in picture interpretation, a constantly increasing number of observations, at least a fair knowledge of vesical physiology and the use of much plain common-sense will soon lead us into fields of diagnostic precision of which we little suspect.

It is important to keep in mind that the normal bladder is attached at its outlet and base and is freely distensible elsewhere. When comfortably distended, if it is not interfered with by contiguous structures, it should present, except at the points named, a series of smooth concavities to the cystoscopical eye. It should have, except at or near the vesical outlet, a uniform type of visible circulation and its musculature should be invisible. The trigone should slope gently toward the outlet, with very little prominence at the posterior vesical lip. The rim of the outlet should be narrow, rounded and show slight, if any, puckering of the mucosa under proper dilatation.

The most usual changes in this normal vesical contour are due to large quantities of fecal matter in the rectum or pressure from the uterus, and should be easily recognized. In women who have borne children there is often a lateral bulging which is also easily

recognized. Limitations to proper dilatation due to other extravesical causes are rarely difficult to determine.

Habit Pseudoatony. The particular habit causing this vesical change is becoming less common as society gradually erases, in its so-called modernizing trend, what we have known as false modesty. It is becoming generally realized, even among the young, that bladders should be emptied from time to time, and it is no longer vulgar to be seen going into places where this can be done. There are still some individuals, usually young women, who make it a practice to empty the bladder only when it cannot possibly hold more urine. The result of this habit is a large, pale, apparently thin-walled viscus. Its tolerance to cystoscopy and the fact that it usually shows fine muscle-banding tracings are prone to raise the question of a spinal-cord lesion. One should not be misled in this regard, as the reflexes are normal and a history of the habit is so easily obtained. They give no symptoms and are found because other conditions have indicated cystoscopy.

Habit Pseudocontracture. The etiological factor in this vesical condition is the reverse of the foregoing and it is likely to be increased by our present social trend rather than reduced. It is the most common form of habit bladder and could very appropriately be called the adolescent bladder. Its possessor is generally a nervous, introspective young man who has for years harbored, as a pet phobia, the dread of being caught somewhere with a full bladder without any opportunity to empty it. For this reason he is always careful to void every time he imagines this could happen. That "flush button" of the bladder, the trigone, becomes more and more sensitive and the summons to void occurs on the least dilatation. The patient finds it necessary to void at shorter and shorter intervals and to arise several times at night.

His physician is consulted regarding his frequency of urination and he is usually considered to be a very baffling case. The diagnoses run the scale of all of those things that are supposed to cause polyuria or frequency, and because no one searches for his psychological kink he is not likely to be cured. The diagnosis does not need a cystoscope but can be made from his history and

by the use of a little arithmetic. The amount of urine passed in twenty-four hours divided by the amount passed at each urination will show the cause of his frequency to be a lessened bladder capacity. Strange to say, this is almost never done in these cases. The history is so easily obtained and the age range of eighteen to thirty years is so constant that it should not mislead. The real result of this habit is gradually to reduce the comfort capacity, because the viscus rarely is dilated. A distinction in these patients must be made between what I have called comfort capacity and true capacity, for it is possible for the physician to fill these bladders by hydrostatic pressure. In doing so he will find that there is an early discomfort which is evanescent and does not recur until he has brought about forcible stretching by a large quantity of fluid.

Cystoscopically such bladders are usually erroneously classed among the abnormally small bladders, as they seem to hold but a very small quantity of fluid. The mucosa is normal throughout, except at the trigone, where it is reddened. There is not the slightest evidence of trabeculation unless dilatation is carried too rapidly beyond the comfort point or the cystoscopy is too prolonged. The trigone and posterior urethra are hyperesthetic.

The cure of this condition rests in the discovery and correction of the cause. The bladder may be forcibly dilated by the physician and applications may be made to the trigone and posterior urethra to render them less sensitive, but the real cure is with the patient. He should be instructed to wait until the third and really urgent summons before he voids. To regain lasting comfort in this regard may take months or years, but it is worth to the patient all the effort it costs him.

Habit Trabeculation. This condition is by no means a rare one and is due to straining to force the vesical sphincter instead of waiting for its normal relaxation. There are millions of vesical sphincters too modest to dilate in company, or perhaps more correctly, hampered by mental inhibitions. Strangely enough, there are many individuals who carry out the same tactics when alone, so that every act of urination is accompanied by an enormous increase in intravesical pressure.

The result of this practice over a number of years is to produce what we call a "back-pressure" bladder. It may be so marked as to show trabeculations and sacculations such as one finds with prolonged prostatic obstruction. The condition may be present at almost any age, as the habit at times exists in infants. I recently encountered such a bladder in a man, aged sixty-eight years, who gave a history of straining at urination all of his life.

The diagnosis is made from the history as well as the absence of vesical neck and urethral obstruction and any evidences of a spinal-cord lesion. One should not be confused by the trabeculation so often seen in intolerant bladders that have been too quickly dilated or in which cystoscopy has been too prolonged. In habit trabeculation the condition is seen when the viscus is first dilated, and such bladders are not intolerant to dilatation unless inflamed, which they rarely are on first study.

If the cause is discovered early, before the trabeculation is too pronounced, correction of the habit will prevent permanent damage. Where sacculation has occurred the bladder itself will require the same attention as given any back-pressure bladder.

It is very probable that this particular method of urinating is a potent factor in some cases of diverticulation of the bladder wall. It is possible, also, that many of the reported cases of "spinal-cord" bladders in which the "cord lesion" could not be demonstrated could be easily explained if the history taking were such as to bring out the patient's habits of urination.

There can be no doubt but that this habit is also a cause of the persistence of many suprapubic fistulæ following prostatectomy. For this reason it would be well for the prostatectomist to pay some attention to his patient's urinary habits if he would avoid this annoying postoperative condition. The intravesical pressure thus engendered could keep any sinus open. The present search for the causes of these sinuses, such as catgut and infection, with repeated probings and cauterization, must be very annoying to the patient and could often be prevented. They should all be taught to relax and not contract in the reëstablishment of urethral urination.

In the attention that has recently been drawn to those patients who, after prostatectomy, develop uremia upon the reëstablishment of "normal" bladder function, it might be well to consider this habit as a possible starting point of the renal back-pressure.

Female Pseudotrigonitis. Among these habit bladders might be included, with some reason, a condition existing rather commonly at or near the menstrual period. It occasions marked frequency of urination, burning and at times some tenesmus. The vesical picture is one of congestion of the mucosa, most marked at the trigone. It is transient, lasting seldom more than a week.

In this relation might also be mentioned a vesical picture of very marked trigonal injection in women in the absence of any pelvic or urogenital lesion. Its annoying symptom is great frequency of urination. I have been able, upon several occasions, to associate this with excessive sexual indulgence, and, upon two occasions, observed it in unmarried women exhibiting the prudery and vulvar appearances commonly attributed to digital masturbation.

A bladder lesion that I have described under the title of "Trigonitis Areata Alba"[1] may also belong to this group of habit bladders, though I am not positive that those who have it should always be subjected to such suspicions. However, its rarity among married women and its frequency among the unmarried of various ages would at least arouse the suspicion that some sexual vice might be a factor in its causation.

In these patients there is marked frequency and burning and often great tenesmus. The degree of discomfort varies with the proximity of the lesion to the vesical outlet. These bladders are usually normal except that upon the trigone occur one or more areas looking as though they had been touched with a silver nitrate solution just strong enough to cause the faintest whitening of the mucosa.

Male Sex Aberrations. In a recent article entitled: "The Cystourethroscopic Pictures of Certain Sexual Irregularities"[2]

[1] Jour. Surg., Gynec and Obst., October, 1924, 510.
[2] Jour. Urol., July, 1924.

I have described several vesical and urethral pictures in the male caused by the patient's sexual habits. These pictures are so easily readable as to aid considerably in our interpretation of a number of symptom groups that have been somewhat baffling. To treat the subject fully it would require a repetition of the former paper, for which reason only a brief outline of these changes will be given.

Great prolongation of the normal sexual act causes a dilatation and tortuosity of the trigonal vessels, a convexity of the surface of the trigone as far back as the plica interureterica and great broadening of the rim of the vesical outlet. After years of indulgence in this habit there at times occurs an exhaustion impotence wherein the patient resorts to masturbation and adds to the picture the typical verumontanum of that form of vice.

Very frequent masturbation causes an enormous enlargement of the verumontanum, injection of the posterior urethral mucosa and occasionally slight reddening of the trigone. These verumontana are generally flattened on top and almost fill the urethral lumen.

Coitus interruptus continued over a number of years causes great enlargement of the verumontanum, but rarely any change in the vesical outlet or trigone. Its history, in contradistinction to the last-mentioned abnormal practice, is easily obtained if asked for.

Ungratified sexual excitement experienced at frequent intervals over a long period of time causes a trigonal convexity resembling that of chronic prostatitis, in that it starts about midway between the plica interureterica and the bladder outlet. The vesical rim is broadened and the posterior urethra is injected, but there is no great change in the trigone and verumontanum.

It has not been my opportunity to study any cases of other sexual aberrations and perversions, but those who do could probably add another very interesting group of pictures to our present cystoscopical atlas.

Careful observation in every case studied should reveal a series of characteristic vesico-urethral findings that now are passed over

in a search for more obvious pathology. With the cystoscope of today it is not a question of one's ability to see, but rather the power to visualize and determine the true relationship of his findings to the underlying and often obscure etiological factors, in which the patient's habits at times play an interesting and an important part.

DISCUSSION

Dr. Alexander Randall: When anyone of us, and I mean the average one of us, looks at a painting we are struck by the beauty that it portrays. It might appeal to us because it recalls in life-like characters a familiar face, or we are impressed with the portraiture of a landscape familiarly or attractively realistic. Now, if one who himself is an artist gazes on the same picture the appeal would probably be the same, but he would see in it details which we appreciate only in the *tout ensemble*. He would appreciate the bold use of purples and blues, which to us simply meant a wonderfully realistic shadow in the landscape; or he would be impressed with a lavish use of whites and glaring yellows which brought out a vivid life-like facial expression. Now, my simile may be poor, but I mean it this way: A great many of us have been looking at bladders through the cystoscope for years—nor is it difficult to teach the beginner the use of the instrument—and in a short while the ability to diagnose grosser lesions which one observes becomes easy. A stone in the bladder, a diverticulum, a vesical tumor or a tuberculous ulceration all paint their pictures, which in a short time become very simple of diagnosis. But the vast majority of cystoscopists have stopped at this point and, fascinated by these picture studies, have not gone further in the interpretation of the finer details of which they were made and have not acquired the facility of interpreting lesser gross pathological pictures to the extent of which they are capable. Now Dr. Pelouze this evening has given you the artistic point of view of cystoscopy, and I hope you see the point of my simile, and that by a close interpretation of the finer points in bladder pathology he has been able to group and classify the finer lesions and slighter variations from the normal, which in themselves represent diseased entities ofttimes of as great importance to the patient as the grosser lesions which I have referred to above. It is but a small paragraph in the chapter of cystoscopy itself, but a part of the big book of medicine, but, nevertheless, such refinements of diagnosis have not been attempted before, and ofttimes it will represent the keystone of an arch upon which the whole structure of a patient's complaint and disease will depend. Dr. Pelouze has been follow-

ing this work for a number of years and has been gifted with the visual faculty to correlate what he sees today with the case that he saw months ago, as also to interpret its pathology and then to translate it again into clinical symptomology, and it is easy to appreciate that once such is accomplished accurate treatment becomes possible. This final ability to interpret, until now overlooked details in bladder portraiture, has still greater significance. A short time ago I was asked to cystoscope a physician, a professor of medicine in his state university. He had had a prostatectomy performed some three years before and with an apparent excellent recovery and only within the last few months a urinary frequency again began to trouble him. There was no recurrent hypertrophy to account for this, but on the right posterior bladder wall was found a suspicious looking area. I asked Dr. Pelouze to look at this, and in the next room, a moment later, he asked me, "Are you ready to agree with me that that is really carcinoma?" I replied that I had suspected it, but was glad of his confirmation. I referred this doctor to his surgeon at home, where a second cystoscopy was performed, and he was advised that the matter be kept under observation. Not entirely satisfied with this, he went to the Mayo Clinic, where the lesion was diagnosed on cystoscopy as a papilloma. However, he insisted on a biopsy, which confirmed our suspicion of malignancy, and even when the bladder was opened at operation the surgeon was loathe to perform a radical operation on what appeared to be a very insignificant lesion, and only because of the confirmatory histological study was complete excision carried out. Again, the pathologist confirmed the original diagnosis and apparently the malignant change involved the mucosa only and did not extend into the musculature. Here, then, was a further example of what such close cystoscopic study may mean and a vivid example of the importance of the interpretation of the finest detail in the changes observed. We have got to get away from this attitude of picture fascination in cystoscopy and follow Dr. Pelouze's example and ability to read more closely the finer superficial changes and interpret them into facts in order to obtain a greater value from this diagnostic portraiture. He has given you but one little chapter which he has worked upon, and I wish to congratulate him upon so successful a termination of his efforts.

Dr. Pelouze (closing): It was Dr. Randall who first called my attention to the possibility of this habit of straining at urination as being a possible starting-point for the renal back pressure after prostatectomy. I think this a particularly interesting observation, and one that means something. In a number of instances you can put a patient on the table and look in the bladder and do not have to ask him what he does; you

can start ten years before and tell him what his habits have been and what his symptoms have been. In the typical cases you do not make mistakes. There are a few atypical cases in which you are wrong at times. It is surprising how many habits will write perfectly readable pictures in the bladder, and yet there is a lot of cystoscopy that we have not learned, for which reason we should correlate our findings.

Two New Antimony Compounds for Intravenous Use

BY ALEXANDER RANDALL, F.A.C.S.

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To anyone watching the current medical literature there has certainly come a realization of a renewed interest in the use of antimony as a potent drug. This renaissance of a very old and trusted remedy, most frequently administered as tartar emetic, is more real than just apparent, and is especially prominent in the English journals, arising from the increasing use of this drug as an intravenous therapeutic agent in various tropical and semitropical diseases of protozoan origin. One finds articles reporting the use of tartar emetic in the treatment of trypanosomiasis, naga sore, kala azar, bilharziasis, schistosomiasis, filaria, Oriental sore, cachar sore and even malaria and the various venereal diseases. Several articles deal with the use of new antimony compounds, a large number of which have been synthetized. At the Ranaghat Hospital, India, 8000 injections of the salts of antimony were given in the one year of 1921, which gives one some idea of the wave of popularity that has accompanied the renewed therapeutic use of this long-neglected drug.

My interest in the drug started in observing the marked value of tartar emetic administered intravenously in cases of granuloma in the Philadelphia General Hospital, where we followed the technic of Aragao and Vianna, who first advised its use in their classical study of the disease at the Institute of Oswaldo Cruz, Rio Janeiro.

These results were really quite startling, and for the first time in the history of the hospital were we able to cure a disease that had long been with us and had added a very large toll to the morbidity of the institution; cases that had repeatedly reëntered the hospital for stays as long as nine months or a year, that at the best received but a temporary healing, some that had hospital records dating back fifteen years and suffering from slow but persistently destructive and crippling lesions were being cured. Sixteen cases were diagnosed and treated during the first year, 7 of whom were found in the hospital at our first search, and during the three years of our interest we saw over 40 cases.

Though we never saw fatal and rarely alarming symptoms to follow the intravenously administration of tartar emetic, yet we never got away from the feeling and the fact that we were dealing with a drug of impure chemical formation and of unstable chemical union, especially when subjected to heat for sterilization, and a drug that almost routinely gave symptoms of toxicity when pushed to the therapeutic limit that we wished. These symptoms varied from attacks of coughing and dyspnea, occasionally bordering on syncope, and associated with marked flushing of the face, to simply the occurrence of deep-seated bone pains, especially manifest about the shoulders and which gradually wore off on exercise. This latter symptom, at times most annoying to some patients, was almost universally present when tartar emetic was administered in decigram dosage on alternating days. This dosage was what we adhered to as a maximum for intravenous therapy.

Because of these evidences of toxicity it was my wish to find an antimonial compound of purer chemical composition, hoping to likewise find one of lesser toxicity. Through the courtesy of Prof. John J. Abel I was privileged to test the efficacy of two new synthetic antimony compounds, sodium antimony thioglycollate and the triamide of antimony thioglycollic acid, which he had studied in experimental rat trypanosome infection. A preliminary report on these two drugs was published in 1923, in which was cited the therapeutic results obtained in 3 cases of granuloma. This disease was chosen on which the drugs could be tested,

knowing the result of antimony therapy in it, a disease in which we were especially interested, and one which we could always find material to work with in Philadelphia.

In these 3 cases of the preliminary report splendid therapeutic results were obtained. In 1 of them a disease of three years' duration was cured in seventeen days, with but 9 intravenous injections, without reaction, and the patient proven free of recurrence six and a half months later. As such had not been accomplished before and only approached by treatment with tartar emetic; as we knew the toxicity of this latter drug, its chemical instability, its constant production of disagreeable symptoms (at times causing the patient to refuse its advantages) and as further experience has shown the therapeutic value and lower toxicity of these new drugs to have far-reaching advantages over tartar emetic, it became desirable that our subsequent experience with them be presented and published and that they be placed within the reach of all.

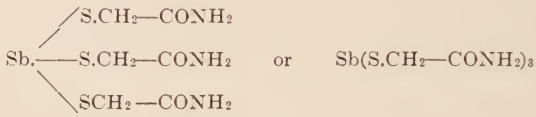
History. Sodium antimony thioglycollate has been known to chemists for a long time, while the triamide of antimony thioglycollic acid was first synthetized by Dr. John J. Abel, professor of pharmacology, Johns Hopkins University. Both drugs were the subject of two articles by Abel and Roundtree in experimental trypanosomiasis. Their experimental work on animals with these drugs, though carried on for trypanosome infections, gave sufficient scientific background as to their toxicity and efficacy to warrant the trial of their use in clinical cases without further animal studies, and even suggested their possible therapeutic value. This was fortunate, as lesions of granuloma inguinale have not yet been successfully produced in the lower animals. One of them, the triamide, had never been used in man before. It was the preparation administered to the above cited case of three years' duration in our preliminary report. Twelve or more years ago Dr. Abel forwarded to some friends in India some of the sodium antimony thiogllycolate for use in kala azar and filariasis, but no report of its use has as yet been made, either to the profession or to Dr. Abel personally. So it might be said that the

initial use of both drugs in infectious conditions in man occurred in the original cases of the preliminary report.

CHEMISTRY. 1. Sodium antimony thioglycollate (antimony sodium thioglycollate) is a white powder, very soluble in water and having a structural formula as follows:

Its antimony content is 37.17 per cent. The aqueous solution can be sterilized by boiling without chemical change other than the separation of a very small amount of antimony sulphide, which can be removed by filtration under sterile conditions.

2. Triamide of antimony thioglycollic acid, or possibly better called antimony thioglycollamide, crystallizes in which glistening plates, m.p. 116.5° C. to 113° C. (uncorr.), and has the following structural formula:



Its antimony content is 30.77 per cent. At ordinary temperature, 100 cc of water dissolves about 0.5 gm. When this solution is cooled some of the compound crystallizes out. It is much more soluble in boiling water, from which it can be crystallized. When pure it is stable in air, otherwise it turns yellow. A solution can be sterilized at boiling-water temperature without chemical change, other than the separation of a trace of antimony sulphide, which can be removed by filtering under sterile conditions. The presence of precipitate of antimony sulphide is to be avoided in administering either drug. It appears as a rusty-colored sediment and probably increases the toxicity. It can always be safely removed by filtration.

Toxicity Studies. These were carried on by intravenous and subcutaneous injections in mice. Sixty-four animals were used. Tartar emetic was tried first to determine its point of lethal dosage on intravenous injection. Its antimony content is 36.16 per cent. The sure lethal dose was found to be 0.08 mg. per gram of body weight and its sure safe dosage 0.025 mg.

The triamide showed a similar point of lethal dosage (0.08 mg.), though when lessened amounts were given its toxicity was lower than tartar emetic. Seventy-five per cent lived as compared to 40 per cent with tartar emetic in similar dosage. The safe dosage remained the same as tartar emetic (0.025 mg. per gram of body weight).

The sodium salt was less toxic. At the above lethal dosage of 0.08 mg. per gram of body weight only 1 out of 4 mice died. Increasing the dosage to 0.1 mg., 5 out of 6 animals succumbed, but only when 0.25 mg. was given was the dose found to be uniformly lethal. Decreasing the dosage showed an absolutely safe limit the same as tartar emetic, but the intervening amounts were relatively less in their lethal percentage.

Summarizing our toxicity studies briefly it appears that the sodium salt, though having the highest antimony content, is the least toxic of the three antimony compounds, though its safe intravenous dosage is equivalent to that of tartar emetic. The triamide is less toxic than tartar emetic, though again its safe dosage remains equivalent to that of tartar emetic.

Figuring these results into terms of dosage for man, one finds that the safe dosage of 0.025 mg. per gram of body weight is the equivalent of a dosage of 1.7 gm to a man of 150 pounds. This is exactly seventeen times more than what has been used as the maximum dosage in our clinical cases and by means of which most satisfactory therapeutic results have been obtained.

Based on these toxicity studies it was decided to limit our dosage to what we had been accustomed to use in administering tartar emetic, *i. e.*, considering 1 decigram as a safe maximum.

Administration. *Triamide.* The usual course pursued was to use 0.1 gm. of the triamide dissolved in 25 cc, it being prepared

sterilized in ampoules of this size. Its solubility being limited to less than one-half of 1 per cent, this size injection was necessary to obtain 0.1gm. of the drug. Later 20 cc ampoules of an accurate 0.4 per cent solution were used, giving a dosage of 0.08 gm. This has uniformly proven to be a non-toxic non-irritant injection in all clinical cases, and at the same time possessing a potentially high therapeutic value. At no time has there been seen any symptoms of intolerance such as we had been used to expect when tartar emetic was administered in maximum dosage, and in several patients who were intolerant to tartar emetic, or regularly developed bone aches, attacks of dyspnea, coughing spells, etc., after tartar emetic injection, were found to take this drug without the slightest inconvenience (Cases 3, 5, 7 and 9).

Sodium Antimony Thioglycollate. With the sodium salt whose antimony content is slightly greater than that of tartar emetic we again adhered to a similar maximum dosage of 0.1 gm. Its solubility being high, it has been used in both a large dilution of 20 cc of a 0.5 per cent solution, and also in the more concentrated form of 10 cc of a 1 per cent solution. It likewise has proven devoid of irritative effect locally as administered and has been borne by all patients without reaction suggestive of antimony intoxication.

Intravenous injection has been the rule because of the violent irritant action which we had learned to expect when tartar emetic was injected extravenously. This intravenous administration has given uniformly excellent therapeutic results and without evident general, local or vascular irritation. Intravenously, either of the drugs should be given every second day to obtain prompt and successful results.

In the complete paper,* 10 cases of granuloma are reported in full. Let me here summarize the results: Five received the triamide, 4 of whom were completely healed (Cases 1, 2, 3 and 5). The fifth patient (Case 4) had to forego further treatment after 3 injections because of the scarcity of the drug to hand at the

* Amer. Jour. Med. Sci., November, 1924, No. 5, vol. clxviii, p. 728.

time: his healing was completed with tartar emetic. Three of the 4 cured patients (Cases 1, 2 and 3), during part of their treatment, received daily maximum dosages of 0.1 gm. over a period of four, five and six days without symptoms of toxicity or intolerance. One of them (Case 3), who had received the triamide in such concentration without the slightest difficulty, when subsequently given tartar emetic, suffered alarming reactionary symptoms, and then again took the triamide without the slightest trouble. This intolerance for tartar emetic and complete toleration for the triamide was again observed in Cases 5 and 9. The complete relief of pain in the lesion immediately following the first administration of the drug was observed in 3 patients (Cases 2, 3 and 4). One patient, and he, one of the cases that was intolerant to tartar emetic (Case 5), was started on the maximum dosage of 0.1 gm. with the first injection and experienced no ill-effects whatsoever. Healing in all these cases was certainly as rapid as we were accustomed to see under tartar emetic therapy, while the sense of security rapidly formed after brief experience with the drug, due to the absence of reactions observed in certain patients after tartar emetic had been administered made one feel doubly grateful for its efficacy at all.

Two patients with granuloma inguinale were treated with the sodium salt: both were healed (Cases 6 and 7). The first received prompt therapeutic results with a remarkable disappearance of a deep-seated induration often accompanying these lesions, until the intervals between injections were allowed to lapse to weekly periods, when a definite slowing up of the healing process was observed. Subsequently a more active therapy established the cure. During his treatment full daily doses of 0.1 gm. were given for three consecutive days without symptoms of intolerance or toxicity. The second patient likewise handled the drug without the slightest trouble, except on one occasion when it was given the day following an administration of tartar emetic, a short coughing spell of fifteen minutes' duration ensued, without change in pulse rate or volume or other untoward symptoms, and on the third and fourth administration of an experimental combination

of this drug he showed antimony intoxication. He was then placed on the triamide and has taken full doses to date without the slightest trouble. Tartar emetic was given to him for a short while and he regularly experienced rheumatoid pains following each injection, symptoms that were absent when taking the sodium salt. He also received the maximum of 0.1 gm. on his initial dose. The therapeutic value of this sodium salt seems equal to that of the triamide. It is difficult to draw comparisons in so few patients, especially so when the evidence is devoid of disagreeable circumstances, and is to be based only on the rapidity of healing, and that in patients whose lesions vary markedly in extent.

Three patients were given injections of both drugs for comparative results. All were cured (Cases 8, 9 and 10). The first of these was given 4 injections of the sodium salt at second-day intervals, followed by 3 injections of the triamide. Prompt healing ensued and no untoward symptoms were experienced. The second had been given the sodium salt at a previous admission. He likewise developed a marked idiosyncrasy to tartar emetic and begged not to be given it. He was given 23 injections of the triamide on alternate days to a complete healing. His toleration of the drug was perfect. The third patient was first given 1 injection of the triamide and then 9 injections of the sodium salt. Healing was established without the slightest reaction to either drug. This comparison allows of no conclusions.

In addition to these the drugs have been administered to 14 other patients suffering from various infections or affections in order to observe their therapeutic value and tolerance. A total of 52 injections of the sodium salt and 13 injections of the triamide were thus given. Three patients were given the full dosage of 20 cc of a 0.5 per cent solution of the sodium salt as their initial injection. They were all received without evidence of toxicity or intolerance. Four were ward patients and their urine was watched for indications of renal irritation without observing such to occur.

Briefly summarized, there have been treated 10 cases of gran-

uloma inguinale: 9 have been cured by these drugs alone while the tenth was cured with tartar emetic during a period of scarcity of the new compounds. The triamide has been administered intravenously 102 times: It has never given the slightest evidence of toxicity and has been productive of a cure in 5 patients suffering with granuloma inguinale, in which it alone was used. A maximum dosage of 0.1 gm. has been adhered to. The sodium salt has been injected intravenously 92 times, to a similar maximum dosage, and excepting the reactions recorded and explained in Case 7, it likewise has been borne without symptoms of antimony intoxication. It has cured the 2 patients in which it alone was used. Two further cases were cured by the administration of both drugs. Five patients showing symptoms of intolerance to tartar emetic have taken one or the other of these new drugs with the complete absence of such symptoms. Five patients have been given the considered maximum dosage as their initial dose and have borne the same without any symptoms. To anyone who has used tartar emetic intravenously at all extensively such successful results as obtained by these drugs will come as a hopeful advance in therapy.

Intramuscular Injection. We have had a few patients in whom intravenous injections were impossible. These had to be denied tartar emetic (and that meant being denied the chance of cure), because intramuscular injection of this drug is impossible. We started toxicity studies on mice, giving the drug subcutaneously. Tartar emetic killed in both 0.1 and 0.05 mg. dosage and was sublethal at 0.02 mg. and below. The triamide, on the other other hand, did not kill 5 mice in ascending dosage from 0.05 to 0.1 mg. per gram of body weight. The sodium salt likewise was not lethal in similar dosage. Here we had striking evidence of lower toxicity of these two drugs, and, moreover, no local irritation was observed. Three of the 10 patients herein reported (Nos. 4, 7 and 9) were tried on subcutaneous and intramuscular injections; 1 had pain without suppuration after a subcutaneous injection, the others were received without any local or general reaction. Two further patients have received 12 intramus-

cular (gluteal) injections of the sodium salt, using 2 cc of a 5 per cent solution. They have all been taken without the slightest trouble. Fourteen intramuscular injections of the triamide have been administered. The low solubility of this drug, necessitating greater bulk injections, is strongly against its intramuscular use. Two of these did suppurate, 1 given in the deltoid on the nineteenth day, the other (gluteal) on the thirty-third day: Each received 12 cc of the solution and faulty technic in syringe sterilization (immersion in alcohol) might have played an important part.

Conclusions. 1. There are presented two new synthetic anti-antimony compounds for intravenous administration.

2. Studies on animals show them to be of slightly lower toxicity than tartar emetic, while clinically they have failed to show any evidence of antimony poisoning, so often observed in using tartar emetic.

3. Clinically they have evidenced no toxicity in the dosages advised, and 5 patients intolerant to tartar emetic have taken these drugs without reactions.

4. Neither of the two new drugs have shown any irritative effect at the site of intravenous injections.

5. Ten cases of granuloma inguinale are reported. Prompt and complete healing, with evident cure, has been accomplished in 9 of them by the use of these new drugs.

6. Immediate relief of pain following the initial injection has been a remarkable manifestation in 3 of the patients.

7. The value of these drugs in other infectious conditions where tartar emetic has proven efficacious may be expected.

8. Both preparations have been given successfully intramuscularly, though one is to be preferred.

9. As antimony belongs in that chemical group that embraces arsenic, mercury and bismuth, the possible value of these new drugs in syphilis might be expected and is at present being studied.

Final Note. Antimony is rapidly receiving well-deserved attention as a drug of high therapeutic value when given intravenously for numerous diseases, especially those of protozoan origin and those ofttimes grouped as tropical diseases.

Reference to Abel and Roundtree's articles gives one a beautiful summary of the subject as applied to trypanosome and allied infections. Faber and Schussler in concluding their article on Leischmaniasis say: "Antimony is probably a true specific. It is still most commonly used as tartar emetic, but without doubt research will discover new combinations that are more effective and less toxic." It is hoped that these two new synthetic drugs may gain a field of usefulness.

DISCUSSION

Dr. John H. Stokes: Dr. Randall has certainly made an admirable contribution to the therapy of an extremely refractory condition. The South American physician, better than anyone else, probably appreciates the problem of inguinal granuloma and will welcome just such a study as this. Certainly, the preparations which Dr. Randall describes are superior to the potassium antimony tartrate usually employed. My own experience with the use of antimony therapeutically began with the attempt to abort a prospective trypanosoma infection by large doses of wine of antimony and arsphenamin intravenously. The patient showed no toxic effects but experienced an enormous loss of weight, from which he never completely recovered. In the intravenous use of antimony salts the atrocious pain in the shoulders and back, of which Dr. Randall speaks, has been an annoying complication. We have seen very little of the coughing and pulmonary symptoms, possibly, as in the case of sodium iodide solution, because of the slow rate of injection. Our most trying reaction was toxic eighth-nerve deafness, which developed in 2 patients quite suddenly after 8 or 9 doses and only subsided two or three weeks after the drug was discontinued. From the standpoint of the diagnostician it is worthwhile to emphasize, I think, that some lesions which suggest inguinal granuloma evidently do not belong in this group and make very little if any response to antimony. These are in all probability the phagedenic chancroids, in which McDonough believes, who has identified an intracellular encapsulated form of the Ducrey streptobacillus. In one such case antimony for a time produced an interesting local reaction with bluing and hyperemia of the lesions, but was unable to bring about a complete cure. In 1 patient with pemphigus foliaceus a temporary striking response to antimony occurred.

I think it will be a happy day when we can introduce more important medicaments intramuscularly rather than intravenously. I believe there

are reasons to suspect a greater effectiveness of intramuscular as compared with intravenous administration, entirely aside from its greater technical simplicity.

Dr. P. S. Pelouze: I have been much interested in watching these cases, and it has been very instructive to see the differences in the administration of the two types of drugs. A number of injections have been given in our dispensary, and when tartar emetic was used we rather looked for what is practically a nitritoid reaction, such as we used to get so commonly with the old arsenobenzole. A man comes in now, gets an injection of the newer preparation and goes out in comfort. It has been very striking, and is undoubtedly an immense advance, as the patient has no fear of the drug. Dr. Randall deserves a great deal of credit for having so carefully worked out the values of these newer preparations as he has.

Dr. Sigmund S. Greenbaum: May I ask Doctor Randall to tell us a little about the chemistry of the compound sodium-antimony-thioglycollate?

Dr. Randall (closing): I would like, if possible, to show you a few slides illustrating the lesion and the rapidity of healing under these new drugs. As regards the chemistry, it will appear in detail in my published article. The synthetic work on it has been done by Hynson, Westcott and Dunning, and it is now on the market through them. In regard to its use intramuscularly, I would prefer the sodium salt, as it is much more soluble, and a smaller size injection can be given. I would caution anyone using either of the preparations, that they are liable to throw down a slight rusty sediment, which consists of antimony sulphide, and apparently increases the toxicity. It can safely be removed by filtration.

Studies in Gastric Analysis: Double Simultaneous Fractional Analysis

by Richard T. Ellison, M.D.

(*Abstract*)

Double simultaneous fractional gastric analysis was performed on a series of patients in an attempt to show the following points:

First, that, although differing in acid values, if a constant relation be maintained between the points of extraction, fractional curves from different parts of the stomach would not cross but be similar.

Second, to show the difference in the physical properties of samples from different parts of the stomach.

Third, to show that the extractions from the antrum give the most information as to the work being done by the stomach.

Charts were shown from which the following summary and conclusions were drawn:

1. Simultaneous fractional analysis from two points in the stomach, definitely fixed 10 cm. apart, produced curves that are entirely similar in their general characteristics except where influenced by biliary regurgitation. The acid values from the antrum were always higher than those from the fundus except where the former were cut by biliary regurgitation. With the bread-and-water meal there is a tendency for the acid values of the two parts to become equal during the second hour due to diffusion of the acid through the fluid meal.

2. There is a recognizable difference in the physical properties of the extractions from the fundus and antrum, this change being due to the comminution of the test substance by the peristaltic activity of the antrum. If this comminution is not found in extractions from the antrum it is evidence that the stomach is not doing a portion of the work that it normally should do.

3. The antrum close to the pylorus is the best place to study gastric function, for there the stomach has most nearly completed its work on the test material and the condition, both physical and chemical, in which the test material will be passed on to the duodenum can best be determined.

4. Fractional analysis, when properly performed, is of great assistance in the clinical determination of the capacity of the stomach for work under the test conditions. It must be firmly kept in mind, however, that the "fractional" feature of the examination does not refer to the contents of the stomach but rather to the work being done by it. It is only by frequent sample

extractions of the result of gastric work that we can form any true conception of the course and completeness of gastric digestion.

5. Biliary regurgitation does not pass beyond the antrum and into the fundus, and therefore its neutralizing effect does not extend to the large mass of food held there, the acidity of which may continue to rise.

6. Biliary regurgitation cannot be considered primarily as a mechanism to neutralize a high gastric acidity, first, because its influence does not extend to the whole stomach contents, and second, because it does occur in the presence of an original low acidity. It seems more probable that biliary regurgitation is an expression of the reverse peristalsis caused by a lesion either directly or indirectly irritating the muscular wall of the intestinal tract.

7. Any change in the position of the tip of the tube during the course of the test alters the findings and defeats the object of the fractional type of analysis.

DISCUSSION

Dr. Harold W. Jones: There is one point, really in form of a question, that is, it is my impression that about 50 or 60 per cent of normal individuals show in the normal residuum a certain amount of bile demonstrable macroscopically as well as microscopically. Is it correct, therefore, to assume the presence of a pathological lesion in the duodenum?

Dr. B. B. Vincent Lyon: I would like to take this opportunity of saying a few words in regard to the paper by Dr. Ellison, because I do not believe that men who are not very familiar with the subject know what a really pretty piece of work he has done. It takes time, ingenuity and patience to carry out even a small piece of research of this sort. Dr. Ellison had very definite ideas in mind as to what he wanted to prove, as he stated in his paper. Fractional analysis, as Dr. Schnabel has said, has been a subject of much dispute. All new methods are bound to receive considerable criticism until the soundness of the method is proved. This is usually brought about by men who study the question intelligently. In some clinics and hospitals today the use of the fractional method of analysis is no more than a name, for nobody seems able to interpret the meaning of their charts except the range of the acid curve. Yet the

fractional method is infinitely better than the older method of single test extraction. Dr. Ellison has shown that there is a tendency for the acid values both from antrum and fundus to run parallel. While the aspirated mixtures are not definitely homogeneous from all parts of the stomach, from the associated values we can rely somewhat more safely upon the accuracy of the acidity curve. A good many men have rightfully taken exception to the attempt to make a correct diagnosis from the acidity values alone. This is sheer nonsense if applied to all cases, and will lead to diagnostic pitfalls. It is by combining gastric secretory analysis with the several points which Dr. Ellison has brought out that the value of the method becomes evident. Even more stress might be laid on the importance of carefully examining the fasting residuum.

Second, I am very glad to see the point Dr. Ellison brought out about biliary regurgitation. I have frequently emphasized the fact that "frank" biliary regurgitation, in my judgment, is one of the most important single signs of extragastric pathology or disturbed physiology (chronic appendicitis, duodenitis or ulcer, gall-tract disease). With the exception of certain neurolabile individuals this is a safe working rule that is later proved by the evidence obtained from biliary tract drainage and *x*-ray studies. Wherever we find frank biliary regurgitation in the morning stomach in a patient who has taken the tube without gag reflex, we will usually find on microscopical examination of the fasting residuum evidence of disturbed physiology or actual pathology. I believe that some degree of duodenitis exists in most cases which produce the reversed direction of peristalsis.

There are other points one would like to speak about, but my main reason for saying anything is to congratulate Dr. Ellison upon this piece of work, which I saw him undertaking in our clinic at the Jefferson Hospital. It takes a long time to get a study like this underway. I remember his great annoyance at a time when he had gotten a number of these cases started and had only two sets of these tubes prepared to work with. Some dispensary nurse came in, carefully cut the tubes apart with a pair of scissors because she could not believe they should be used together, and it took Dr. Ellison many days to get them right again.

Dr. Ellison (closing): In answer to the question as to the percentage of biliary regurgitation, that is one of the moot questions connected with gastric analysis. Sixty per cent is a rather high estimate and depends on what is considered normal in individuals being tested; there are a good many states of disturbed innervation which give you biliary regurgitation that do not show demonstrable gross pathology. Dr. Schnabel suggested the question of biliary regurgitation will soon be taken out of the realm

of chemistry and put into one of nerve connection, and Dr. Alvarez's conception of the way material is moved on through the gastrointestinal tube, the gradient idea, explains this better than the chemical explanation. He has shown that any lesion irritating the musculature of the intestinal tract increases reverse peristalsis, both as to its frequency and degree, and a lesion in the appendix or sigmoid may cause a reverse peristaltic wave and will traverse almost the entire intestinal tract, and it is probably these cases that show high percentages of regurgitation without demonstrable pathology in the duodenum or stomach.

The Onset of Clinical Auricular Fibrillation and Flutter

BY CHARLES C. WOLFERTH, M.D.

(*Abstract*)

In 1923 I reported before this society 2 cases exhibiting fleeting rapidly recurring paroxysms of intermittent slightly impure auricular flutter, a form of arrhythmia not previously recorded. The mechanism of onset of paroxysms was briefly described and commented on. During the past year a case with similarly fleeting rapidly recurring paroxysms of auricular fibrillation has been studied. In view of the like incidence of the arrhythmia to that of intermittent flutter this condition has been called intermittent auricular fibrillation. The numerous onsets of paroxysms recorded in these 3 cases have offered a unique opportunity to study the mechanism of onset of auricular flutter and fibrillation.

Conceivably the circus movement might be excited either by a normal sinus beat or an extrasystole, or might arise spontaneously during a priod of auricular inactivity. It has been shown in animal experiments that circus movement is more readily produced when the refractory period is prolonged and local temporary barriers to the passage of the excitation wave produced. Thus, De Boer was able to produce fibrillation in frog ventricle by a single stimulus applied just before recovery from the preceding beat.

Cases Presented and Illustrated with Lantern Slides. In Case I all onsets of flutter were identical, being initiated by premature auricular beats. The periods from premature beats back to beginnings of preceding normal beats, varied from 0.40 to 0.52 second. Following the premature beats there was continuous acceleration of auricular action up to point of offset which usually occurred after four or five cycles. There were also numerous isolated premature beats of the same type as those followed by the flutter after-effect, also successions of premature beats constituting very brief paroxysms of auricular tachycardia.

In Case II nearly all paroxysms of flutter were initiated by premature auricular beats occurring throughout a wide range of auricular diastole. Those occurring late were apparently quite as effective in exciting flutter as the highly premature beats. Occasionally a paroxysm was initiated by an auricular beat of normal type. There was acceleration of auricular action during the first two or three cycles of paroxysms, then regularity was established and maintained either to offset or until the last one or two cycles preceding offset.

In Case III (intermittent auricular fibrillation) there were likewise numerous premature auricular beats, all of which were fairly accurately coupled with preceding auricular beats. Some of the premature beats initiated short paroxysms of fibrillation while others, apparently identical save for the after-effect, were isolated. A comparison of onsets of numerous paroxysms of fibrillation revealed the fact that the irregularity was not haphazard, but, according to plan, since observation of contours of curves and measurements of summits demonstrate that the excitation wave pursued the identical irregular course in all. This hitherto unrecorded type of behavior in auricular fibrillation brings striking confirmation to the statements of Lewis, Drury and Iliescu that there is a certain definite channel for which the central excitation wave in fibrillation has a predilection and that fibrillation is, in reality, a form of advanced impure flutter.

In summarizing our observations it is possible to say, as a result of study of onset in over 200 individual paroxysms or

auricular flutter and 30 paroxysms of auricular fibrillation, that premature beats are vastly more effective in exciting the circus movement than normal beats. A sinus beat may, however, serve as the starting point of a paroxysm.

Such disturbances of rhythm as intermittent flutter and fibrillation occur only when the auricular muscle is in a state highly receptive of the circus movement. The nature of this alteration in function is not known with certainty, but there is much to suggest that fault in recovery from the refractory phase is of importance. Under such circumstances barriers to conduction might be expected to arise, favoring the entrance of the circus movement, and particularly after premature beats, when less time for recovery of muscle has been available. This is a possible explanation as to why premature beats are so much more effective than normal beats in exciting paroxysms.

It is not to be inferred from the foregoing that an attempt is made to attach grave importance to auricular extrasystoles *per se*. Occurring in hearts otherwise sound they probably never excite the circus movement. It is only in cases where functional alterations are present, inviting flutter or fibrillation, that extrasystoles offer the easiest portal of entry for these more profound disturbances of rhythm.

DISCUSSION

Dr. James E. Talley: Dr. Wolferth's statement that you may find paroxysmal auricular fibrillation occurring in patients who have had auricular premature beats brings to mind a man eighty years of age, under emotional stress, who came with a simple tachycardia broken by occasional auricular premature beats. On one occasion we secured a good curve showing the change of the regular rhythm to a paroxysm of auricular fibrillation. These recurrent attacks of total irregularity occurred from time to time.

Since auricular fibrillation and auricular flutter both depend upon circus movements, we should expect to find clinical relationships. It is nowhere better seen than in those cases of auricular fibrillation under quinidin which pass to auricular flutter.

We have patients in whom for at least three years auricular fibrillation

has passed to a regular rhythm every time quinidin was taken anew for the relapse, and sometimes we have caught the intermediate stage of flutter in our curves. The most discouraging patients are those who under the influence of quinidin pass from fibrillation to flutter and there remain. The relationship is also depicted when flutter passes to fibrillation and then to a regular rhythm when under digitalis.

That auricular fibrillation may be the deciding factor in provoking symptomatology in arteriosclerotics with impaired circulation is evidenced by two patients who come to mind. Some time ago a woman of seventy years developed attacks of unconsciousness and clonic movements in the right arm. These attacks recurred frequently during two years and every attack we witnessed was accompanied by paroxysmal auricular fibrillation. These attacks of Jacksonian epilepsy have long since ceased and her rhythm is now constantly regular.

Again, another woman of about fifty years of age, with a rheumatic heart somewhat enlarged, always has edema when fibrillating, but is free from it when the rhythm is kept regular with quinidin.

In a circulation where the interval between competence and incompetence is narrow the onset of auricular fibrillation may tip the scales in the wrong direction. If the patient is one whose heart responds to quinidin the outlook is bettered. These patients practically ration themselves on the quinidin.

Another patient with paroxysmal auricular fibrillation was a man of about forty years of age, with typical mitral stenosis. He died suddenly, probably from embolus, months after I saw him. So far as known he was not taking any medicine at the time of death.

Experimental Aortic Regurgitation

BY H. C. BAZETT

Regurgitation has been produced aseptically by passing a mushroom-shaped stylet down the carotid artery and forcing it through one or more valves. Holes may be made in two valves at once without any severe symptoms and the animal is not recognizable from a normal dog except for a fast pulse rate. Three valves can be punctured and the animal can survive if the damage is done in two stages.

The initial change noted is a much increased pulse rate (often 100 per cent change) with a *diminution* in the size of the heart shadow. The heart becomes much narrower but is often somewhat lengthened.

After some months the heart shadow is much greater and the pulse rate slows somewhat, though it still remains very fast. Thus in one dog, operated on twice (February 21, 1924, and April 11, 1924), the heart shadow area had increased 41.4 per cent, (October 28), the length being increased 27.5 per cent and the breadth 16.7 per cent. With the increased heart size an increased duration of the *Q-R-S* group is found and the height of the *Q* and *R* waves are much increased in leads II and III, the *S* wave being actually diminished.

The lengthening is explicable only on the basis of a considerable regurgitation of blood into the left ventricle from the aorta. The diminution in the shadow of the heart is readily explained by the change in pulse rate, since if the minute volume circulated remains the same the output of the right ventricle and of each auricle per beat must be about halved. The increased size of the left ventricle is almost, but not quite, able to balance this.

The theory advanced by H. A. Stewart, and recently revived by Wiggers, that a regurgitation of pressure without a regurgitation of fluid occurs, is not based on sound physical principles and would completely fail to account for these results. Actual measurement of the degree of leak after death indicates that with a difference of pressure such as is likely to have existed in some of the dogs fluid should have leaked back into the heart at the rate of 3.5 liters per minute, which, with the duration of diastole actually observed, should have given a leak of 18 to 10 cc of blood between each contraction.

DISCUSSION

Dr. George W. Norris: I first of all, wish to apologize for my incompetency to discuss a paper of this kind which is so purely experimental and physiological, but I cannot help but feel that it must be of great interest to all of us mere clinicians to have heard the very explicit exposition and very interesting results which Dr. Bazett has quoted. So far

as I myself am concerned, it gives me great comfort because I have never been able to quite grasp the teaching that there was no regurgitation in aortic insufficiency, it seemed to me not only from the standpoint of common sense, but from the standpoint of clinical experience that there must be a good deal. There is nothing for me to criticize in this piece of work. I would merely like to ask Dr. Bazett one or two questions which, he did not allude to, and which perhaps he is not at present in a position to discuss. I would like to know whether the difference in arm and leg pressures which exists in human beings, occurs in animals experimentally, and if so how soon this phenomenon is manifest? Dr. Bazett and I have had a number of discussions on this subject as to the difference between arm and leg pressure which according to physiology, that I was taught, was impossible. I would like to know whether Dr. Bazett has been able to arrive at an explanation of these clinical phenomena. I would like to know whether there is a difference in the intensity of the heart sound after valvulotomy is produced. Of course the general teaching in regard to heart sounds is that one cannot have a loud heart sound unless a considerable period of presphygmographic tension exists. This teaching explains the well known clinical phenomenon that weak murmurs and weak sounds are often heard when compensation is worst and that when the heart gradually improves in strength the heart sounds and murmurs increase in intensity.

Dr. James E. Talley: I wish Dr. Bazett would emphasize his experiences with the time interval between the experimental aortic valve lesion and the appearance of the evidence of preponderance, electrocardiographic or anatomical. In literature it is stated that this interval need not be a long one.

Williamson found that the marked difference in blood-pressure in the arm and leg in aortic incompetence was not constant in adults. He also found that changes in the muscular coats of the arteries with or without sclerosis played an important rôle.

This seems substantiated by the fact that he found this difference in pressure between the arm and leg occurred twice as often in adults as in children, whose arteries are not hard.

Dr. James M. Anders: I recall the work of Thayer and McCallum who produced experimental aortic regurgitation and made the statement that their results strikingly confirmed the view held by many observers that the left ventricle plays a very important rôle in closing the aortic orifice. We know clinically that a much dilated left ventricle may cause relative aortic regurgitation. Thayer and McCallum also state that immediately over the aortic orifice, the murmurs produced in these experi-

mental cases are quite loud, but over the vessels higher up and the body of the ventricle lower down these murmurs could scarcely be heard. I would like to know whether the present experiments yielded any results of this nature.

Dr. Bazett (closing): I am glad that Dr. Norris brought up the question of differential pressure. We have made a number of experiments on differential pressure in dogs, and it was largely due to Dr. Norris that I came to realize that the clinicians did not exaggerate as much as I thought they did. I found to my surprise that the systolic pressure in a dog with aortic regurgitation was often 50 mm. higher than that in the carotid. I tried it further with a schema, and the difference seemed due to the kinetic energy of the mass of fluid in the aorta in direct line with the femorals and undergoing rapid changes in velocity in aortic valve lesions. When the motion is hindered, as the blood meets the resistance of the arterioles, this kinetic energy is converted into pressure. I would have dealt with it in detail, if it had not just appeared in print (*American Journal of Physiology*). My only sad moment was when I had first developed this theory and listened to Dr. Sailer on differential pressure in thyroid cases. On mere clinical grounds and on sound general principles he arrived at much the same point of view before I did, so that clinicians have taught me many things in aortic regurgitation.

Then as to the occurrence of this differential pressure in health. It seems to me that this must certainly often occur, if it is a velocity effect, and it should whenever the circulation develops high velocities and considerable kinetic energy. Some students have been working at this and find that after exercise they were able to get 99 mm. higher systolic pressure in the leg than in the arm while lying down. So I think it mainly a result of kinetic energy. The question of whether the intensity of the heart sounds is greater or not I cannot answer.

Dogs are rather intractable; they will lie usually quite quiet. The pulse-rate definitely affects the size of the heart shadow. Meek has recently analyzed these changes in the dog. The shadow becomes about normal size in two or three weeks and full developed hypertrophy does not reach its maximum until five, six or eight months. It develops slowly even when you give the animals exercise.

I think that answers most of the questions, except the one as to the condition of the heart muscle in aortic regurgitation. I am afraid I cannot answer that from my experiments, because I have examined these animals from x-ray and electrocardiograms, but I have not otherwise examined the heart. I should imagine the heart muscle is in fairly good condition In spite of the regurgitation the tone of the muscle is improved either by sympathetic activity or the cutting out of vagal tone.

Extra-abdominal Conditions Simulating Acute Abdominal Diseases

BY DAVID RIESMAN, M.D.

Surgeons have coined the linguistically objectionable phrase, the acute abdomen, to express acute abdominal diseases requiring as a rule operative treatment. The abdomen, however, can be neither acute nor chronic any more than a leg or an arm can be acute or chronic. But as the phrase has come into popular usage, as everyone understands what it connotes, and as it expresses tersely what otherwise would require a lengthy paraphrase, its use may be condoned.

The sudden onset of pain of severe character in the abdomen, together with signs and symptoms indicating an acute intra-abdominal lesion, imposes upon the physician, since he is usually the first one to be called, the duty of making a correct diagnosis and of deciding whether the treatment shall or shall not be immediate operation.

Experience and experiment have taught us that, owing to the integrating action of the spinal cord centers, pain impulses coming from the periphery may be referred to areas of the body not in direct contact with the part from which the pain impulses primarily arise. Therefore, it happens that pain in the abdominal wall may have its real origin elsewhere, and that pain arising in the region of some abdominal viscus may by a like perversity manifest itself in another and remote part of the body.

These well-attested facts impose upon us the obligation of determining, when confronted with acute abdominal symptoms, whether the pain and tenderness are in reality of intra-abdominal origin or whether they arise elsewhere. We must not assume that abdominal pain of necessity means abdominal disease.

The "acute abdomen" is counterfeited most often perhaps by pneumonia, which may simulate the symptoms produced by appendicitis, gall-stone colic or perforation of an ulcer. To those who have never seen the perfect mimicry of appendicitis by pneumonia

the possibility even of such a thing is hard to conceive. Yet there are few large hospitals in which cases of pneumonia have not been operated upon in the belief that the correct diagnosis was appendicitis. How frequent this error is can readily be seen from the report of Adams and Berger[1] that 25 patients out of 145 suffering with lobar pneumonia were sent to Boston City Hospital with a diagnosis of appendicitis.

There is only one rule for avoiding mistakes, and that sometimes fails, namely, to make a thorough examination of the chest as well as of the abdomen in all cases with acute abdominal symptoms. The leukocyte count often gives no help; yet we should remember that more than 20,000 white cells per cmm. is a rare finding in appendicitis, and is suggestive either of pneumonia or of a pus collection somewhere in the body. Rectal examination is of value in that it may, in doubtful cases, confirm the diagnosis of appendicitis.

An apparent gall-stone colic or cholecystitis is sometimes only a masquerade, the disease being a central lobar pneumonia or perhaps a pleurisy. The following case is pertinent.

R. L. M., aged forty-two years, six weeks before coming under my observation was seized with a cold, chills and fever, and dull pain in the right upper abdomen. He was in bed for about a week and then became jaundiced, and in addition had almost daily a severe outcrop of urticaria. The jaundice and the upper abdominal pain led his physician to diagnose inflammation of the gall-bladder and biliary obstruction. When he came to my office he had a temperature of 99° F., pulse 120, blood-pressure 100/85, and was slightly jaundiced. The urine contained bile. In the previous history there was nothing of moment except an attack of empyema thirty years before, for which he had had a rib resection. Physical examination showed to our great surprise, and to the greater surprise of the family doctor, that the right chest, the one that had been the seat of empyema before, contained pus almost up to the clavicle. The hepatic symptoms were apparently due to pressure upon the liver and perhaps to a toxic hepatitis.

[1] Jour. Am. Med. Assn., 1922, lxxix, 1809.

So it happened that instead of having a gall-bladder operation, as he had been led to expect, the patient had another rib resection.

One of my surgical friends once asked me to see a case of gall-stone colic. The history was quite in accordance with the diagnosis. The patient, about forty years of age, was jaundiced, his liver was enlarged, and the right upper quadrant was tender. The man, however, was sicker than the usual patient with a gall-stone attack, and I was not surprised upon examination to find that he had a pneumonic patch in the lower lobe of the right lung.

Even simple pleurisy may produce pain in the abdomen completely overshadowing, unless a thorough examination is made, the trouble in the thorax.

Another "acute abdomen" of thoracic origin was seen in a woman brought into my wards at the Polyclinic Hospital a number of years ago. She had a history of acute pain of sudden onset and was distinctly tender in the epigastrium. A tentative diagnosis of acute gall-bladder inflammation was made. On the following day there was a perfectly definite pericardial friction sound. Hence pericarditis must be put into that pigeon hole of the brain where we keep the misleading causes of the acute abdomen.

Much more important than pericarditis as an occasional cause of acute abdominal symptoms is coronary thrombosis. Intensely severe epigastric pain, shock and vomiting—as typical an "acute abdomen" as one can imagine—may be the symptomatology by which thrombosis of a coronary artery manifests itself. I have seen such a case diagnosed as gall-stone colic. An interesting feature, which to my mind corroborated the diagnosis of coronary thrombosis in that case, was that the man had suffered from intermittent claudication and had no pulse in the dorsalis pedis artery.

It must, however, be admitted that it is very difficult at times to distinguish between coronary thrombosis and gall-stone colic, perforated ulcer and acute pancreatitis. Careful examination, however, may show absence of epigastric tenderness in the coronary affection, perhaps a pericardial friction sound and slight fever. In addition there is usually a history of precordial pain or distress and even of genuine attacks of angina pectoris.

In one case of rupture of a dissecting aneurysm of the aorta that I saw, the pain in the beginning was so sharply abdominal that both the family physician and I thought we were dealing with a violent attack of biliary colic and summoned a surgeon in consultation. We finally decided that the patient did not have gall-bladder trouble, that the condition originated in the heart, but the real nature of it was only revealed by the autopsy, which showed as the cause of the pain a rupture of the aorta through the wall of a dissecting aneurysm. One symptom was present in this case that I have not seen in biliary colic or other acute abdominal disease: The patient assumed the knee-chest position or rested on all fours, that being the only way in which he could get a modicum of comfort.

It is, of course, well known that the pain of true angina pectoris may be referred to the abdomen, in the region of the gall-bladder. I have seen a goodly number of cases in which it was very difficult to say whether the patient had gall-stones, renal colic or angina pectoris. The fact that sudden death of distinguished persons is so often attributed to acute indigestion, which rarely if ever kills suddenly, gives proof of the close similarity between the pain of abdominal and that of cardiac origin.

In this connection it is worthy of mention that gall-bladder disease, as I pointed out a number of years ago, may in time lead to cardiac derangements.[1] This result is to be explained on the theory of focal infection. Hence gall-bladder trouble and angina pectoris, gall-bladder trouble and myocarditis, may come to exist together, and may be abolished by operation upon the gall-bladder. Sometimes the cardiac affection, although a secondary result, dominates the picture and completely obscures the underlying disease of the gall-bladder. However, if the case is properly analyzed, the heart condition, other things being equal, will be found dependent on disease of the gall-bladder and will not be considered a contraindication to operation but rather an indication for it.

[1] The Development of Cardiac Murmurs During Attacks of Biliary Colic, Jour. Am. Med. Assn., 1907, xlviii, 1589, 1590; Cardiac Murmurs During Attacks of Biliary Colic, Am. Jour. Med. Sci., November, 1911.

I now pass to some other extra-abdominal affections that may cause what appears to be an acute abdominal syndrome. First of all I would mention *tabes dorsalis*. The gastric crises of this affection may simulate gall-bladder colic or intestinal obstruction or other abdominal conditions. Since they sometimes appear before locomotion, station or sight is interfered with, they may be misinterpreted. Operations for supposed intra-abdominal disease are not infrequently performed in such cases. If the Wassermann test is negative in the blood it should be tried with the spinal fluid. I have seen two patients who had been operated upon, one for gall-stones, one for gastric ulcer and for gall-stones, separate operations; a third patient was to be sent to operation for intestinal obstruction—all three were cases of tabetic crises. In a fourth patient, one physician had made diagnosis of hysterical vomiting, another of intestinal obstruction. The blood Wassermann was negative, but in the spinal fluid it was strongly positive. The patient died after many attacks, the autopsy proving the correctness of the diagnosis of tabes dorsalis. This patient's attacks were characterized by painless wretching and vomiting; all the others suffered great torture during their seizures.

One should make it a habit to test the knee-jerk in all adults with acute non-febrile abdominal symptoms; should examine the pupils, inquire about bladder symptom and about syphilis, and, as mentioned above, make the Wassermann test. It may not be unwise to sum up the outstanding features of gastric crises as they appeared in my cases:

1. The attacks repeat themselves with monotonous uniformity.
2. Vomiting is very severe and persistent.
3. Attacks often last as much as two weeks, reducing the patient to a skeleton.
4. Pain may be intense or it may be absent.
5. Neurologic findings suggest or prove the true nature of the case; with this proviso, that we may not find the characteristic triad, Argyle-Robertson pupil, absent knee-jerk, and disturbed station and gait, in combination.

Uremia, that protean disease, is capable of mimicking almost any disease from brain tumor to the "acute abdomen." I have seen a patient made ready for operation, on the basis of a diagnosis of intestinal obstruction, in whom I found the symptoms to be due to uremia. On the other hand, it is not uncommon to find the diagnosis of uremia based on the presence of albumin and a few casts in the urine, an intra-abdominal or pelvic lesion being overlooked. I remember a woman with persistent vomiting, abdominal pain and the urinary findings just mentioned. Her physician had made a diagnosis of uremia. Pelvic examination revealed a mass which I thought might be a twisted fibroid tumor, but which at operation proved to be an ovarian cyst twisted on its pedicle.

That tonsillitis may produce acute abdominal symptoms seems not very well known. I have seen a few such cases, of which the following may serve as a type:

F. H., aged sixteen years, was taken ill with sharp pain in the right lower abdomen, vomiting and fever. There was distinct tenderness in the appendix area; the leukocyte count was 14,000; pulse, 140; temperature, 99.4° F. The case looked like one of appendicitis; I was, however, struck by the intense redness and injection of the pharynx. On the day following the onset the abdominal tenderness was nearly gone, but the throat showed a typical follicular tonsillitis. On the third day the patient was entirely well.

My friend, Dr. Conaway, of Atlantic City, has told me of a similar case.

It is evident that the throat is another locus which the alert physician must examine before concluding that appendicitis exists.

Lead poisoning may be mistaken for intestinal obstruction. Oliver[1] speaks of a case admitted to the surgical wards of the hospital to be operated on for what appeared to be intestinal obstruction. There was absolute constipation, severe abdominal pain, fecal vomiting and low temperature with signs of collapse. But as there was also retraction of the abdomen, a blue line on the gums

[1] Oliver: Lead Poisoning, p. 139, New York, 1914.

and albumin in the urine, the patient was not submitted to operation. He died two days afterward from uremia due to plumbism. At the autopsy the kidney was found to be atrophic and there was no evidence of intestinal obstruction. There is no reason why a lead worker should not suffer from appendicitis like other people, but the history of the occupation of the patient and a careful examination of the abdomen as to the seat and character of the pain as well as of the outline of the abdomen generally should cause us to hesitate, and not with undue haste rush into an operation.

That hysteria may feign the "acute abdomen" is readily conceivable. About two years ago I saw with Dr. J. C. Doane, of the Philadelphis General Hospital, a trained nurse who had once had an abdominal operation, a gastroenterostomy, for supposed peptic ulcer. When I saw her she was vomiting, had a great deal of abdominal distension, tenderness and pain, and almost total suppression of urine. At first we though of tuberculous peritonitis or some other more or less acute abdominal process; also of hysteria. The patient was carefully watched to see whether she was voiding any other urine than that the nurse was able to collect, but we could not find at that time anything to support the suspicion of hysteria. The young woman went home somewhat better; several months later she came back to the infirmary of the hospital with convulsions. Bearing in mind the suppression of urine during her previous sojourn in the hospital, it was thought that the convulsions were uremic, but after she came out of them it was found that she had corneal anesthesia and other hysterical stigmata, which made the diagnosis of hysteria inescapable. This conclusion was abundantly substantiated by further observation. Looking back, we decided that the abdominal symptoms in the former illness had also been due to hysteria.

The following case in the practice of a surgical acquaintance illustrates another cause of the "acute abdomen:" A young woman was brought into the hospital with the history of being taken acutely ill with abdominal pain and vomiting. As she had in addition tenderness and rigidity in the right lower quadrant and

a leukocytosis, a diagnosis of appendicitis was made and steps taken to operate. At the last moment sugar and ketone bodies were discovered in the urine and other evidence of diabetic acidosis was found. Inquiry then brought out the fact that the girl was a diabetic, using insulin, and that she had run out of insulin. Immediate administration of the remedy brought a prompt cure with disappearance of all symptoms of appendicitis.

In rare instances thyrotoxicosis produces vomiting and diarrhea of such severity that one may be easily led to suspect a primary abdominal disease. The signs of exophthalmic goiter, or perhaps the history (as in a case I saw a short time ago) of a recent operation on the thyroid gland, gives the explanation.

Angiospasm. The pain of angiospasm in the lower extremities—intermittent claudication, and in the heart—angina pectoris, is well known. That similar conditions may occur in the abdominal arteries may be conjectured, although proof is difficult to bring. I have seen a few cases in which acute abdominal pain of great severity seemed to be satisfactorily explained on this basis. The following is a case in point:

S. L. B., aged sixty-seven years, suffered for years from a mild form of diabetes mellitus. He consulted me on account of cramps in the legs coming on if he walked any distance on the street. After resting for a few moments the pain would disappear and he could continue his walk. Examination showed absence of the pulse in the dorsalis pedis artery, and *x*-ray study of the lower limbs demonstrated with exquisite clearness calcification of the arteries. After a time symptoms of angina pectoris appeared, and a little later severe attacks of pain centrally located in the upper abdomen. These latter pains came on with the same suddenness and disappeared with the same suddenness as the anginal attacks. I attributed them to spasm of the celiac axis. There was thus in this man an involvement of three different arterial systems, but that was not all. On one occasion he complained of sudden dimness of vision. I sent him to Dr. de Schweinitz, who reported to me that the man had a tetranopsia, which we attributed to a vascular crisis in the cuneus.

The symptoms of the so-called *erythema* group of Osler sometimes simulate appendicitis so closely that, when the underlying cause is not thought of, the wrong procedure is sure to be undertaken. A few years ago there was in my wards of the Philadelphia General Hospital a young Italian with mitral stenosis. One day he was seized with signs and symptoms of acute appendicitis. When I saw him I remembered that in cases of old rheumatic endocarditis erythema multiforme sometimes causes abdominal symptoms. Careful search revealed a few patches of eruption on the skin and by the following day the body was extensively covered with the characteristic rash. Nothing further happened, the abdominal symptoms disappeared without residue.

Herpes zoster. One of the most curious cases of the acute abdomen in my memory is that of a woman, about seventy years of age, who was suddenly seized with sharp pain in the right upper quadrant. To those who saw her it seemed to be an attack of biliary colic. When I came to examine her I found over the lower chest and upper abdomen on the right side a few small reddish points grouped in patches of coin size. The condition looked like an early herpes zoster. In a day or two the lesions were typical. Dr. Litchfield, of Pittsburgh, has reported a few similar cases.

My purpose has not been to discuss the intra-abdominal causes of acute abdominal symptoms, but to point out those extra-abdominal conditions that in their close mimicry of truly abdominal diseases create diagnostic difficulties and lead to errors in judgment resulting in unwise and dangerous procedures.

DISCUSSION

Dr. John H. Gibbon: My experience in the errors of diagnosis and improper surgical intervention and my observation of these errors lead me to believe that they are not due to the fact that we do not know the difference between the clinical pictures, but that it is due to the habit of taking the apparent diagnosis and settling upon it, instead of thinking of the other conditions which might produce a similar picture. This has been so much impressed upon me that I have endeavored to make internes and students develop the habit of making a diagnosis and then immediately

mentioning all the other conditions that the symptoms might suggest. A hurried or incomplete diagnosis in the type of case Dr. Riesman has talked about may be followed by a serious mistake in treatment—an unnecessary operation. I think then we need to avoid the snap diagnosis, or if we make a snap diagnosis we should develop the habit of immediately trying to tear it down by considering other possible diagnosis. I know no other method of avoiding error.

Another cause of error in diagnosis and treatment, I think, is that in our endeavor to avoid overlooking a perforation of the gastrointestinal tract, or an acute inflammatory condition in the abdomen, we have operated upon these cases without sufficient study. All these conditions which Dr. Riesman has enumerated, or practically all of them, would bear study even if they later prove to require surgical intervention. There are markably few real surgical emergencies outside of obstruction of the respiratory tract and hemorrhage. There are very few surgical emergencies that require immediate operation, and yet we rush these patients into the operating-room without thorough examination.

Most of us can recall illustrations of the mistakes in diagnosis which Dr. Riesman has put before us. I remember very well a case of dissecting aneurysm of the aorta I saw with him at night and being only a mere surgeon I could only say I thought the trouble was above the diaphragm. I saw today 2 cases of angina with gall-bladder symptoms or histories suggestive of gall-bladder infection; 1, a man, seventy-four years of age, relieved of attacks by taking nitroglycerin, who had pain down both arms and numbness and some abdominal tenderness; the other, a man forty-five years of age, who had all his pain in his cardiac area and with pains down his arms. This man had no temperature; he had not anything to make me feel he had any abdominal lesion. The question of herpes: I have seen more than 1 case. I remember a man seventy years of age, who was supposed to have appendicitis. I did not think he had appendicitis; I did not know what he had. The doctor telephoned me the next morning that he had a beautiful crop of shingles. Dr. Finney reported some years ago a number of instances of measles in children who had been operated upon for appendicitis. They developed measles immediately after operation. The acute chest conditions will stand a few hours' watching and, notwithstanding the old theory that morphia obscures symptoms, I think a hypodermic of morphia often does a lot to clear up the situation in these cases. But if we would only take a little time for study, and if we would not call things emergencies, and if we would wait a few hours the situation would often clear up and a serious error be avoided.

Another point about this question, of course, is that one may err on the other side. In looking for the unusual one may overlook the common

condition, and this is an error I think we not uncommonly commit. I remember operating last spring on a man, seventy-four years of age, for gall stones, who had been treated for six months for abdominal angina.

I think that our mistakes in certain cases will continue, but they will not be half as frequent if we will develop in our internes and our students the habit of making a differential diagnosis. I think every surgeon ought to be willing to write down his diagnosis, or his probable diagnosis, or two or three diagnoses, in their order of choice, and he ought to be willing to acknowledge his mistakes. And may I make the same suggestion to the internists?

Dr. Joseph Sailer: This paper contains valuable suggestions. Hysterical patients may present extraordinary abdominal conditions. One patient was able to produce a phantom tumor, that is, a hard, temporary swelling in various parts of the abdomen. Apparently it was produced by muscular contraction. The patient refused to let me make photographs of it. Another patient had attacks of intense pain, accompanied by fever and hematuria, during which numerous large stones were passed. At no time has the *x*-ray shown stones within the body, although they all contained calcium. The cystoscopic examination and catheterization of the ureters have failed to show the existence of any lesion. The patient has hysterical stigmata. In the course of a few seconds the abdomen of this patient may enlarge and become boardlike.

It is a mistake, even in very obvious cases, to neglect the examination of the back. In a patient recently brought to me, with a diagnosis of gastric ulcer, the symptoms of which were severe nocturnal pain preventing sleep, there was tenderness over the spinal processes of the eleventh and twelfth dorsal vertebræ and a very slight deformity. The *x*-ray confirmed a diagnosis of Pott's disease.

It must always be remembered that although a perfectly obvious lesion may be found in the thorax that could cause abdominal symptoms, nevertheless, it is possible that some lesion in the abdomen may coexist. I remember the case of a woman, seventy years of age, with a blood-pressure of 250 +, who had typical attacks of angina pectoris and also attacks of pain in the right upper quadrant, from whom a large gall stone was successfully removed and she was afforded much relief.

A patient with a thoracic aneurysm complained of pain in the epigastrium. From time to time he expelled small quantities of blood from the esophagus. We ascribed all the symptoms to the aneurysm, which we supposed was rupturing, but at the autopsy it was found to be intact and there was a large ulcer in the stomach, undoubtedly the source of the hemorrhage.

Dr. George W. Norris: It might be of interest and certainly has been unique in my experience of abdominal pain, to give an instance in which I was at least in part the cause of an unnecessary operation which occurred in a patient of mine a number of years ago in the Episcopal Hospital. A young individual had typhoid fever and in the third week developed acute right-sided abdominal pain, drop in temperature, swelling and extreme rigidity. Dr. Ashhurst saw the case with me, we both decided she probably had perforation. Operation did not go very far because on cutting through the abdominal wall he found she had Zenker's degeneration of abdominal wall and found nothing in the peritoneum. That is one of the curious and rare things that we ought to bear in mind when we have unusual cases of abdominal pain.

Dr. Riesman (closing): Acute exanthemata should always be borne in mind as they are often atypical in the offstart. Dr. Sailer's advice to examine the back is well taken, and brings to my mind a case very like the one he has described. The gall stone case of Dr. Sailer's bears out what I said in my paper.

NOVEMBER 24, 1924

A Study of All-day Blood-sugar Curves in Non-diabetic Individuals and in Diabetic Patients with and without Insulin

BY T. GRIER MILLER, M.D., LEON JONAS, M.D.,

AND

IDA TELLER, A.B.

Despite the many excellent studies on the use of insulin in diabetes there has as yet been evolved no satisfactory routine method of regulating the dosage and the time of its administration. It is obviously to be desired that the doses be as small and the administrations as infrequent as possible, and yet that, with a diet adequate for maintenance and reasonable activity, the blood-sugar concentration throughout the day be held within normal limits. To accomplish this requires, in the first place, an appreciation of what the normal blood-sugar values throughout the day

are, and, secondly, an understanding of the effects which various diets and insulin dosages and certain combinations of these produce in diabetics. Only by intensive studies of the blood-sugar concentration on large numbers of individuals, both normals and those in differing stages of the disease, can this knowledge be obtained. Our purpose in this communication is to present the results of such investigations, which we have made in the University of Pennsylvania Hospital during the past year, and to develop certain general rules for the use of insulin in the management of cases of diabetes. Incidentally we will suggest a simple practical method of estimating the full-day blood-sugar level in individual cases. First, blood-sugar curves obtained from non-diabetics on adequate diets will be presented, then those from mild and severe cases of diabetes without insulin, and finally those from diabetics who were receiving insulin.

In six curves on non-diabetics with mixed diets a rise in the sugar level after each meal was observed. When the interval between breakfast and luncheon was only three hours the rise after the latter meal was less than that after breakfast but when the interval was four or more hours the second rise was equal to or greater than the first one. It will be noted that the curves from the mild diabetics have the same general features except that they are consistently on a somewhat higher level. In these especially is the high after-breakfast portion of the curve interesting, inasmuch as the sugar concentration often exceeded the threshold value for glycosuria only at that time. This is the justification for the common practice of giving insulin to these mild cases only before the first meal of the day. It is not, as sometimes supposed, because the insulin has an effect throughout the full day. In our more severe cases without insulin the sugar concentration is seen to be high in the latter part of the day as well as the morning, one curve keeping well above the threshold value for glycosuria throughout the day. These would necessarily, if kept on the same diets, require an insulin effect continuously.

Our other curves represent experiments with the administration of insulin to diabetics in varying stages of the disease. In the

beginning we followed the Toronto plan of giving it before each meal, believing that it was not effective for more than four hours on the average and wishing to supply it at the times that food was being absorbed. It soon became apparent, however, that unnecessarily low blood-sugar values in the afternoon were being obtained. One of us (L. J.) showed this in a previous communication. It is also to be seen in curves published by Wilder, Boothby, Barkorka, Kitchen and Adams, by Williams and by others. Consequently we learned that the midday dose of insulin could well be dispensed with. The dose before supper, however, in all but the very mild cases, is clearly indicated, as many of our curves in which this dose was omitted will show. In certain others even small doses of insulin in the late afternoon were not sufficient to keep down an evening rise. We also discovered that in many severe cases large doses of insulin before supper did not prevent glycosuria and high blood-sugar values in the early morning.

In an effort to overcome this high morning blood sugar we experimented with a midnight dose of insulin, thus giving these patients three doses a day at approximately eight-hour intervals (8 A.M., 5 P.M. and midnight). Knowing that recovery from the effects of the insulin given before supper did not occur until about that time we did not feel that it was safe to give it earlier. It need here only be noted that Allen and Sherrill have emphasized the need for an insulin effect continuously in such cases, no matter how the food is administered, in order to care for the glycogen which is constantly being broken down. They favor its administration before each meal and in certain severe cases at six-hour intervals. Still more recently Allen has suggested that the last dose for the day be given an hour after supper or at bedtime. Our data, however, indicate the uselessness and possibly even the harm from hypoglycemia of a midday dose in the ordinary case. When two doses a day, given before breakfast and supper respectively, do not rid a patient of glycosuria and the morning fasting level remains high, we unhesitatingly favor the extra dose being given late enough in the evening to definitely reduce the early morning value. This we believe is much more apt to occur if it

is given within at least eight hours of the morning feeding, usually about midnight. Whether or not a small amount of carbohydrate should be given at the same time to overcome the possibility of hypoglycemia within the next hour or two depends upon the patient's clinical reaction or a blood-sugar determination made one or two hours after the administration of the insulin. In some cases we have found it necessary. On the other hand we now have under observation a woman who has been receiving 15 units each midnight without any food and at no time has she showed any evidence of hypoglycemia.

Reviewing all our curves it will be noted that, without insulin, the highest blood-sugar concentration usually occurs one hour after breakfast, and, with insulin, either at that same time or just before the administration of the first dose of insulin for the day. They show also that practically the lowest blood-sugar level, without insulin, is to be found just before breakfast, and that, with insulin as we have used it, the lowest level is just before lunch or in the mid-afternoon. From this it follows that the high and the low points in any case may be discovered by making in one day three routine determinations: one before breakfast or before the first insulin administration, if that is being used, one an hour after breakfast and one just before lunch. By means of these three estimations a reasonably accurate picture of the full-day curve can be formed. For practical purposes these are the only determinations of the blood sugar needed in the ordinary case, though in certain severe ones it may be helpful to know in addition the level in the early evening, an hour after supper and at midnight.

Another point of practical importance may be drawn from the fact that in diabetics without insulin the highest blood-sugar concentration develops soon after breakfast. If sugar occurs in the urine it would be expected in greatest amount at this same time. We have repeatedly found this to be true, glycosuria often being present at only this time in the day. In consequence, when only a single specimen of urine can be obtained in suspected cases of diabetes, as often happens in office practice, one voided an hour or more after breakfast should be secured.

Summary and Conclusions. 1. A series of thirty-four blood-sugar concentration curves, covering periods up to twenty-four hours, on 29 patients, 6 non-diabetic and 23 diabetic, are presented in an effort to work out a more satisfactory routine method of regulating the dosage and the time of administration of insulin to diabetics.

2. The ideal method is not arrived at, but the following general rules for the management of such cases seem warranted:

(*a*) With a maintenance diet equally distributed among the three meals of the day mild cases of diabetes may be kept within the normal limits of glycemia by means of a single dose of insulin administered a half-hour before breakfast.

(*b*) More severe cases require in addition to an adequate morning dose a second but somewhat smaller one a half hour before the evening meal.

(*c*) When the morning fasting level of blood sugar cannot be kept below the threshold value for glycosuria by these two doses a third one is indicated at about midnight.

(*d*) The amount of insulin to be administered at each time must be determined by blood-sugar estimations made before and after the meals.

3. When insulin is not being given and the diet factors are the same for each of the three regular meals the highest blood-sugar concentration occurs usually about one hour after breakfast and the lowest is before breakfast.

4. When insulin is used, as above suggested, the highest point may be attained before the first insulin administration of the day or an hour after breakfast, while the lowest point is usually reached just before the midday meal or in the mid-afternoon.

5. For practical purposes it is suggested that in the study of all diabetics three blood-sugar determinations should be made on one day, one on a specimen collected before the breakfast or before the first administration of insulin, if that is being used, one an hour after the breakfast and a final one just before the luncheon. By these three estimations a reasonably accurate picture of the full-day curve can be formed.

6. In all cases of diabetes the single specimen of urine that is most likely to show sugar is one voided one to two hours after breakfast.

DISCUSSION ON THE PAPERS OF DRS. MILLER AND JONAS AND MISS TELLER

Dr. Henry K. Mohler: Dr. Miller and his associates are to be congratulated on the very excellent study and presentation of a subject which is of the greatest interest to every physician who is treating diabetics. Every one has noted the more of less irregular manner in which some diabetics respond to the administration of insulin as measured by their degree of reduction in the hyperglycemia and the glycosuria.

There is little I can add to Dr. Miller's paper. I should like to make several inquiries. Were the blood-sugar curves obtained from the same patient on different days under like conditions and with what results? We have observed that the glycemia and glycosuria of some patients on calculated diets and a fixed dosage of insulin vary from day to day. The cause of this lack of uniformity of response to insulin is difficult to satisfactorily explain. I have been interested in the explanation offered by Friend, of New York, who believes that the ordinary blood-sugar tests and urinary tests for sugar, measures not only the sugar but the adrenalin content of the blood and the urine, and that it is due to the latter that the variance in glycemia and glycosuria occurs. I should like to know if Dr. Miller and his associates have an opinion on this method.

Dr. J. Harold Austin: I want to express my admiration for this piece of work which it seems to me is the most important contribution in the dosage and timing of insulin that has come out in connection with its use as used in actual handling of a diabetic. It presents us evidence which certainly makes it necessary to revise the conceptions we have had as to timing of the insulin dosage, gives us a picture of the mechanism of the diabetic metabolism and its response to insulin which is quite a new one. I think it is an extremely helpful contribution.

Dr. Orlando H. Petty: I also very much enjoyed the paper of the evening. I would like to raise the point, however, as to whether exercise has something to do with the lowering of the blood-sugar curve during the day. It, of course, has been demonstrated many times experimentally that exercise does alter blood sugar and that we are more active during the daytime even if in bed when the blood sugar was low. Another point

that may have some bearing upon the high blood sugar following breakfast is the assimilability of the carbohydrates consumed for breakfast which gives a reason for a more rapid rise after the breakfast meal. They are also more rapidly absorbed from the intestinal canal. I think it is the general practice of the majority to give a midnight dose in severe cases and use the smallest dose, if any at all, at the midday meal. Of course the high blood sugar in the morning with the use of insulin is very easily explained by that being the longest period during which the patient is without insulin. His endogenous pancreatic secretion probably remains the same. Conversely, with the diabetic it is usually accepted that diabetics without insulin have their lowest blood sugar in the morning and that is explained by the fact that the night is the longest period without food.

DECEMBER 22

Blood Transfusion in Pernicious Anemia

BY HAROLD W. JONES, M.D.

Blood transfusion in pernicious anemia, if correctly administered, produces better and more permanent results than any other therapeutic measure. Although it has been in use for many years, the results have not always been satisfactory. These poor results have been due chiefly to four factors: (1) Failure to cross-agglutinate before each transfusion; (2) the use of improper methods of transfusion; (3) the injection of too large or too small amounts of blood; (4) too long an interval between the transfusions. Many have said that transfusion did little good; others that it seemed to retard progress and a few that it definitely shortened the life of the individual, all of which has served to bring discredit upon this very useful therapeutic measure.

The institution of typing by Shattuck, in 1899, gave added incentive to the use of transfusion by increasing its safety. However, there arose the terms "universal donor" and "universal recipient," which were responsible for many serious hemolytic reactions, for it was soon found that even if the two individuals were the same type it was possible that either sera might agglu-

tinate the cells of either. Accordingly cross-agglutination was developed, which has distinctly lessened the number of serious reactions. It has since been found that the type may change in a few instances after a transfusion, and therefore it is better to cross-agglutinate before each transfusion even though the same donor is used.

Method of Transfusion. The citrate method was instituted by Lewisohn to offset the bad feature of Lindeman's method; that is, coagulation in the instrument. There can be no good reason for adding a foreign body, such as sodium citrate, to the blood if a method is available that permits of the transfusion of blood without coagulation. The Unger method fulfils this requirement. Moreover, the injection of 2 per cent sodium citrate solution has produced death. Blood platelets are destroyed when this method is used. Reactions are more common with citrated blood than with whole blood. In view of these facts it is evident that whole blood transfusion is the method of choice.

Many patients with pernicious anemia have very small veins, but it should seldom be necessary to expose the vein in order to insert the needle. Frequently there may be only one or two available veins, and, if these are exposed, incised or tied off, it prevents the easy use of that vein for another transfusion at an early interval, and especially is this true when as many as twenty to thirty transfusions are given to one individual.

Amount of Transfusion. It has been the custom in the past, and still is in some clinics, to administer large amounts of blood at a single transfusion; that is, 800 to 1200 cc. This amount in a disease in which the total serum is not reduced places a strain on the heart muscle. Dr. Harold Pardee has shown that the myocardium in pernicious anemia is degenerated, and therefore the injection of such large amounts is attended with real danger. It has also been suggested that the injection of large amounts of blood may depress the already weakened bone-marrow function.

Dr. Colwell, of Pittsburgh, brought forward the use of small amounts of blood (20 to 50 cc) given frequently, and showed that in a certain number of patients the blood elements were

increased. The use of small amounts of blood should not be discarded, for between transfusions, when there is some delay in getting a donor, it may prevent a fall in red blood cells and hemoglobin until such time as a moderate transfusion can be given. Fifty cubic centimeters of blood will not, however, furnish sufficient blood elements to materially reduce the urgent symptoms so often seen when the hemoglobin and red blood cells are at a low ebb. Its use is definitely contraindicated in such states. Enough blood should be introduced to produce the desired effect, that is, to lessen or remove the symptoms resulting from the deficient oxygen-carrying power of the blood. Our plan is as follows: In very urgent cases, where the patient is unconscious or stuporous, 450 to 600 cc is usually sufficient to carry them past the danger-point to a more normal state. In patients whose hemoglobin is between 20 and 30 per cent, red blood cells 700,000 to 1,000,000, and who do not suffer from the urgent symptoms of the first group, it seems better to give a small transfusion of from 150 to 250 cc at the first transfusion. This is also true when the anemia is less severe. It has been our experience that serious hemolytic and severe febrile reactions are very prone to follow the first transfusion; also that when more than a week elapses between transfusions reactions are more common and more severe.

Interval between Transfusions. From a critical study of the behavior of the transfused blood we found that in pernicious anemia the hemoglobin and red blood cells were increased following the transfusion, but that within three to seven days a drop occurred in the majority of instances. This reduction in hemoglobin and red blood cells is often greater than the increase, bringing the blood count to a lower level than before transfusion. Because of this fact, when the interval between transfusions is great the good accomplished by the first transfusion is lost. The second transfusion produces a similar result, and because of this little good can be seen to come from transfusions in pernicious anemia. Having too long an interval between the transfusions has been responsible for more of the poor results in pernicious anemia

than any other single factor. To overcome this we give the transfusions every four to six days, thereby stimulating the blood before it has time to drop. By giving smaller amounts of whole blood every four to six days we have been able to bring the blood to a normal limit in nearly every patient with pernicious anemia. Using this amount, we are able to use the same donor more frequently.

Reactions may occur with whole blood transfusions. They may be of several varieties, as follows: (1) Chilly sensation; (2) rise in temperature of 1° to 2°; (3) chill plus rise in temperature; (4) urticaria pruritis, subglotic edema, pulmonary edema; (5) mild hemolytic characterized by petechia; (6) severe hemolytic reactions, petechia, ecchymosis, jaundice and hemoglobinuria. The first four types of reactions are not harmful to the patient; the hemoglobin and red blood cell counts are not affected. The hemolytic reactions are dangerous, may result in death and require other methods of transfusion in order to bring about improvement in the patient.

There are some obstacles that one is bound to meet in treating pernicious anemia patients by transfusion. If the patient is unfortunate enough to be a Type I or III (Moss) it may be difficult to find sufficient donors. Second, it may require from five to fifteen transfusions in order to bring the blood to normal figures. It is seldom that the patient has a sufficient number of friends or relatives who match perfectly. In order to obtain donors it usually means the outlay of from twenty-five to fifty dollars for each transfusion. Then, too, until the hemoglobin is 50 per cent and the red blood cells 2,500,000, the improvement is usually much less marked than after this point is reached. Sometimes several transfusions will be given with very little sign of improvement. These obstacles, however, are not unsurmountable and the results obtained warrant the effort.

The following statistics demonstrate what may be accomplished with transfusion in pernicious anemia. There were 26 patients, of whom 10 died and 16 are living. Of the 16 living, 2 are confined to bed; 4 are in bed part of time; 2 are working

part of time; 8 are performing their various duties. Three hundred transfusions were given these patients. The smallest number of transfusions to produce a satisfactory result was three; the greatest number fifteen.

Of the 16 living—

1 man worked seven years after last transfusion.
1 man worked two years and two months; still in hospital.
1 woman worked fourteen months; working.
1 woman worked sixteen months; working.
1 woman worked nine months; working.
1 man worked fifteen months; working.
1 man worked eight months; in hospital.
1 man worked five months; working; nearly normal count.
1 man worked ten months; working.
4 unknown.
2 just discharged.
1, only one transfusion; result questionable.

Of the 10 deaths—

1 lived thirteen months; refused more transfusions; brought to normal twice.
1 lived twelve months; died from reaction six hours after transfusion.
1 lived seven months; refused more transfusions when drop from normal occurred.
1 brought to normal in twelve transfusions; normal one month; pneumonia.
1 lived eight months; thirty-five transfusions—hemoglobin, 82 per cent; red blood cells, 3,800,000 at death; pyonephrosis, pneumonia.
1 lived seven months; no donors.
1—hemoglobin, 80 per cent; red blood cells, 3,800,000; hemolytic reaction.
1 had three transfusions; no donors.
1 had seven transfusions; no donors.
1 had one transfusion; death two days after.

What can we hope to accomplish with blood transfusion in pernicious anemia.

1. To save life in those cases which present urgent symptoms.

2. To alleviate unpleasant symptoms and give patient added strength and hope.

3. To stimulate a so-called remission.

4. To carry the patient along at a higher nutrient level with the hope that he will develop a remission. It is reasonable to assume that he has greater opportunity to develop a remission with the blood above 50 per cent than when it is between 20 and 30 per cent.

5. To bring about in a few patients what appears to be a cure.

In order to accomplish these results the following points must be adhered to:

1. Give a small amount of blood (200 cc) at the first transfusion to offset the possibility in a very few cases of death from a peculiar reaction, unless the case requires a larger amount to bring him to a margin of safety.

2. Use whole blood.

3. Use moderate amounts—350 to 450 cc.

4. In the hemolytic stage give increasing amounts daily, beginning with 50 cc.

5. Give the blood at four-day intervals.

DISCUSSION

Dr. James M. Anders: The paper of Dr. Jones is certainly a most interesting one and if future observations confirm the results of his observations then it will prove to be epoch-making. As we all know, the treatment of progressive pernicious anemia is most unsatisfactory and hitherto any case in which this diagnosis was made, and recovery ensued, we very seriously doubted the correctness of the diagnosis. The sole object of treatment until the present, has been to prolong life and to put the patient in a better general condition while he lived. Of course, if cures can be accomplished in a goodly number of cases by pursuing the method employed by Dr. Jones it will mark a distinct advance over previous methods of using transfusion. Kimpton years ago, said that transfusion of blood skilfully employed offered more than anything else in progressive pernicious anemia and I think many clinicians have come to the same con-

clusion in recent years, particularly those who have had considerable experience of the use of transfusion in these cases. I do not feel, however, that we should rely upon a single measure or method alone, in the treatment of these cases, notwithstanding the excellent results obtained by Dr. Jones. Arsenic has a well established reputation in the treatment of this disease and certain hygienic means are of considerable value. How do transfusions help these cases? Is it because of the fact that we introduce new blood which inhibits hemolysis, or is it because the introduced blood increases the oxygen carrying power of the blood? I think this is still a moot question, although I incline to the belief that the effect is brought about by inhibiting hemolysis.

About five years ago I presented a paper on this subject before the Association of American Physicians and in that paper I analyzed 450 cases, a few of my own and the rest collected from the literature. The results confirmed the view expressed by Weber, Hurter and others that frequent, smaller transfusions, for example from 200 to 500 cc, give better results than a single large transfusion. Hence the remarkable results obtained by Dr. Jones, could not have been obtained because of the particular size of the dose he employed, since others had employed similar doses. His splendid results must have been due to the fact that the dose was frequently repeated. Now in the paper I referred to, I made the statement that it is advisable to give these moderate-sized doses, and to repeat them sufficiently often to prevent the development of a serious type of anemia as long as possible. I am firmly convinced that the earlier we begin this method of treatment in progressive pernicious anemia the better the results. It has been the custom of clinicians as a rule to wait until the hemoglobin percentage was down to 20 per cent or the red count below 1,000,000 and this I think is distinctly inadvisable. If a case of anemia is met with and diagnosticated as pernicious anemia, then by all means should this method of treatment be instituted at once. The question, Shall we use either whole blood or citrated, or defibrinated blood? is also one of much importance. More than ten years ago Vogel and McCurdy said the use of fresh unmodified blood was an agent of great promise in this disease. In the cases I analyzed five years since more than half had received citrated blood. Since vascular surgery has made it possible to transfer blood from one person to another safely I think whole blood should be preferred, more particularly since the effect seems to be better than from the use of either citrated or defibrinated blood. The reactions as we have learned tonight, are, as a rule, not dangerous ones, although the hemolytic reaction, referred to by Dr. Jones is always very much dreaded. I do not think defibrinated blood should be thought of at the present day. Formerly it was given intramuscularly and intra-

venously, as we know, but it is certainly inferior in its effects to either citrated or the unmodified blood. The question has always interested me, Can transfusion precipitate a remission? In the cases I analyzed according to the reporters, remissions were initiated in more than 50 per cent by the transfusions. It is, however, a very easy matter to mistake, or to confuse the initiation of a remission during an exacerbation of this disease, with a mere hastening of that remission when one is imminent. I think we will all agree that when a remission is about to occur and you perform a transfusion, it is very likely to hasten that remission, as pointed out by Libman, but just how often a true remission is initiated by a transfusion during an exacerbation is still a moot question although I feel sure it does sometimes occur. Formerly most writers advised against giving transfusions during remissions, but Dr. Jones must have given them irrespective of remissions, since he administered them every fourth day until the blood was restored to about the normal, when he could find the proper donor. I think Dr. Jones was wise in employing cross agglutination; he thus obviated serious difficulties. Formerly, I felt confident that transfusion tended to increase the duration of remissions and I still think the earlier transfusions do this, but after giving a number of them in a given case, one finds that the effect becomes more transitory and therefore the question whether transfusions prolong the life of a case of progressive pernicious anemia is still an unsettled one in the opinion of many writers. Personally, I think they are capable of prolonging life, but whether they do or not, one thing is certain, they improve the patient's general condition and make life much more comfortable. I think the paper as I said at the outset, is a very interesting and very important one and if subsequent observations of other clinicians confirm its findings then surely they will mark a distinct advance in our knowledge of the treatment of pernicious anemia by transfusion.

Dr. W. Egbert Robertson: I would like to ask a question. In reading his paper the author referred to 2 of the cases which were transfused in the hemolytic phase. I wondered whether he had paid special attention to the hemolytic as contrasted with the myelopathic groups. It seemed to me that the myelopathic types would be possibly the ones which would not respond to transfusions. I have never had any conviction myself as to the value of transfusion in pernicious anemia until I heard this presentation of Dr. Jones'. I have never been very greatly impressed with the importance of transfusion over a long period of time. I felt somewhat as Dr. Anders stated that possibly they initiate a remission and we know how frequent remissions are. Osler reported a case which lived for ten years and Cecil Drinker a case which lived for twenty

years, the remission having lasted for that time. I am especially interested in learning whether the myelopathic cases responded as did the hemolytic. As to the method of transfusion I am convinced that whole blood offers the best results, although the last one I personally transfused died about thirty-six hours later. He was what we took to be the myelopathic type. He did badly while being transfused and died on the following day, practically unconscious for most of the time following the transfusion. Whether the introduction of a foreign protein is a factor, although it is of an homologous type, is a point of importance, because we know that foreign proteins influence colloids. The life of red blood cells has been determined. The life of these cells is not sufficiently great, however, to justify the thought that you have in any sense replaced the blood. It must be that the foreign proteins stimulate the bone-marrow, and under these circumstances it is most probable that the hemolytic groups will more frequently respond in a favorable manner than the myelopathic cases.

Dr. Joseph Sailer: I made some observations in transfusion. Apropos of the remark by Dr. Robertson that probably the foreign protein stimulated the bone-marrow, I have, in a number of cases, counted the blood daily and sometimes found the maximum count from the third to the fifth day. If it were simply a matter of increase of the total quantity of blood, the highest figure would be found on the first day. The question of fever is very interesting. Many cases of pernicious enemia have a febrile course. One case interested me greatly, a young women who for three years had been kept in fair health. On the occasion of a third transfusion from a brother, after careful tests, she develops a fever. This continued for some time. The two previous transfusions from her brother had been satisfactory. We then transfused from a sister who had been used before. The fever immediately subsided. No examination enabled me to discover the cause of the fever. The patient did not seem noticeably disturbed by it. I have noticed that, even though the fever may be fairly high it is far less debilitating than in other conditions. Perhaps theoretically the direct method appeals, but if there is any difference in the result these differences are difficult to perceive. I think the results are just as satisfactory in all my cases by either method. I shall be very glad to hear Dr. Jones state what evidence he has that the direct method is preferable to the citrate, because if there is any definite proof I think it should be presented. There is still another method of transfusion which I think might profitably be used—the intravenous injection of living washed red blood cells. Finally, it would be very interesting to know in the cases reported if any were of the aplastic type or not.

Dr. Anders: I did not refer to the stimulating effect of the blood introduced in transfusion upon the blood-making organs, because if my memory serves me, those who have made a study of the blood after transfusion have never found any marked increase in the young cell forms. It does not seem to me possible, therefore, that the effect of this measure is attributable to a stimulation of the blood-making organs.

Dr. Jones (closing): I wish to thank these gentlemen for the very kind discussion of my presentation. The question of just how much of the results of blood transfusion are due to the new blood and how much are due to remissions, is a difficult one to answer. There is, however, no doubt in my mind that most of the results are obtained from the transfused blood. Occasionally improvement would have resulted no matter what was done. But when patient after patient is improved by this method of transfusion I believe that those results should speak for themselves. We do expect repeated transfusions to stimulate remissions or to carry the patient along at a high level until a remission occurs. We feel that a remission is more likely to occur if the blood elements are at a high level than when they are at a low level. When 400 cc of blood is transfused the average increase in hemoglobin is 5 per cent, and in red cells is 300,000 to 500,000. If the blood elements increase 10 to 20 per cent and 500,000 to 1,000,000, it is the best indication of bone-marrow stimulation. We have followed the effect on the reticulated reds and nucleated reds but have not found them reliable indications of improvement.

Dr. Robertson spoke of the aplastic or myelopathic types of pernicious anemia. Two of this group might be classed under that heading. One died after receiving 35 transfusions, hemoglobin 80 per cent; red cells 3,980,000. Pyelonephritis was the cause of death. The other died two days following the first transfusion.

We believe the whole blood method to be superior to the citrate method. It is quicker, cleaner, no foreign body is injected, the blood plates are not disturbed.

Infectious Icterus

BY JOSEPH SAILER, M.D.

On August 15, 1922, I was asked by Dr. Wm. M. Lashman, of Camden, N. J., to see with him a man aged fifty-one years. He had been sick nine days with chills, fever and pains all over the

body. Jaundice had appeared early and had become steadily deeper. The pains became more severe and he felt and gave the impression of being gravely ill. The physical examination yielded little, but was nevertheless important. The jaundice was intense, involving the skin, sclera and mucous membranes. The throat, head and lungs were normal. The liver was not perceptibly enlarged, nor was anything important found in the abdomen. The reflexes were normal. There was some diffuse tenderness all over the body and the calf muscles in particular were exquisitely tender, so much so that he objected to a second attempt to squeeze them.

I suggested the possibility of Weil's disease, and the following day Dr. Rubinstone examined the patient's blood by dark-field illumination and found a few typical parasites, although it was then the tenth day of the disease. It was my intention to have the urine also examined, but unfortunately the specimen taken to Dr. Rubinstone's office was spoilt during transmission and it could not be used. Laboratory examinations were difficult. The Wassermann test was negative, the urine contained a slight amount of albumin and bile and the differential count of the white blood cells showed 70 per cent of the polymorphonuclear forms. Dr. Lashman informed me that the patient made an uneventful recovery.

On October 3, 1924, a white man aged forty-four years, was admitted to my wards in the Philadelphia General Hospital. One week previously he had been drenched in the rain. He had sudden headache, went to bed and felt stiff all over. The next day he vomited and his nose began to bleed, and this continued for two days. The pain in the muscles of the lower limbs was severe and extended from the hips to the ankles. He was told by his neighbors that he was turning yellow.

The previous history included measles, mumps and pertussis during childhood, a chancre at seventeen, a left inguinal bubo requiring an operation at eighteen and several attacks of gonorrhea. At thirty-six he had begun the use of morphin, and had twice been in institutions for the cure of this habit, both times unavailingly. He had always used alcohol to excess when possible to obtain it.

In 1923 he was cut under the eye in an automobile accident. He lived in the cheapest lodging-houses.

The findings of the physical examination were: Cyanosis of the lips, ears and fingers; yellow and injected skin and sclera; normal throat, heart and lungs; a liver that could be palpated 3 cm. below the costal margin. The urine contained a trace of albumin, hyalin and granular casts, a few red blood cells and bile pigment. There was slight anemia, no leukocytosis, normal blood chemistry. Hemolysis began at 0.46 per cent and was complete at 0.26 per cent sodium chloride solution. The Van der Berg test was positive for obstructive jaundice. An attempt to obtain the duodenal contents was unsuccessful.

On October 4, about the eighth day of the disease and the second day of his stay in the hospital, some urine obtained as aseptically as possible was injected into a guinea-pig, and fifteen days later a report was received from the laboratory that the Leptospira icterohæmorrhagica had been isolated from the urine of the guinea-pig and the diagnosis of Weil's disease confirmed. The subsequent course was one of rapid improvement and on October 10 he was discharged at his own request.

In 1886 Weil reported 4 cases of a peculiar disease, 2 of which had been observed in 1870 and 2 in 1882. The patients were all men, 3 of whom were twenty-two years and 1 twenty-three years of age. The symptoms in all cases were similar, and consisted of fever, prostration, headache, dizziness, anorexia, severe pains throughout the body, especially the limbs, vomiting after the administration of calomel, diarrhea and jaundice. The spleen and liver became enlarged during the course of the disease; the urine contained albumin and casts. The fever lasted for six, nine, nine and twelve days, and in 3 of the cases a mild relapse or recurrence was observed. All the patients recovered. He discussed various diagnoses, particularly acute yellow atrophy of the liver, relapsing fever, yellow fever, bilious typhoid, a condition that had been described by Griesinger, and renal typhoid. Although he admitted that it had close affinities to abortive typhoid with jaundice and nephritis, he concluded that it was probably a morbus sui generis, but he did not suggest any name for it.

Subsequently many cases were reported which added three facts to Weil's description: That the disease was epidemic, that many of the patients were butchers, and that the muscles were tender, especially the calf muscles.

A febrile disease with jaundice and often occurring in epidemics was not new. Indeed it had been described in the eighteenth century, and as early as 1812 in the United States, and many times in European medical journals. (Noguchi, Blumer, Heiser, Valassopuolo.) Weil, however, focussed attention upon it and described more accurately its symptoms and course.

In 1914 five Japanese investigators (Inada *et al.*) stated that earlier in the year they had discovered in the blood and urine of patients suffering from the disease odan-eke, (a name that means icteric pestilence) a spirochetal organism. To this organism they gave the name Spirocheta icterohæmorrhagica and proposed the name Spirochetosis icterohæmorrhagica for the disease. This spirocheta is intensely pathogenic for guinea-pigs and has been transmitted from one to another with persisting virulence fifty-one times. In the tissues of the guinea-pigs it is found most abundantly in the liver, and an emulsion of the liver, if injected into susceptible animals, produces a fatal disease characterized by jaundice. The organism is pleomorphous; it is only visible by the dark-field illumination, and it stains by the Levaditi and other methods employed for spirochetæ; it passes through the Berkefeld filter and grows on the Noguchi media; it penetrates the intestinal mucosa, and, what is more remarkable, can penetrate the shaven abdominal skin of a guinea-pig in five minutes or less. I suspect that it is possible for it to penetrate also human skin. It is found in the blood of the human patient until the seventh day, and subsequently escapes by the urine, in which it can be found until the fortieth day and exceptionally even longer. The blood of the convalescent patients possesses bactericidal properties, and numerous experiments were performed to discover an immune serum. The immune bodies appear from the fourteenth to the twenty-eighth day of the disease and persist at least as long as five and a half years. A goat was immunized and produced a serum

with curative and protective properties. Salvarsan was of doubtful use.

Another group of Japanese investigators (Ido *et al.*) were able to produce active immunity in guinea-pigs, which are the most susceptible animals hitherto discovered and none of which normally survives inoculation. They used livers from inoculated guinea-pigs emulsified in 0.5 per cent carbolic acid and kept in an ice-box for a week. This so attenuated the virus that it was possible to inoculate guinea-pigs with it, and these would survive and could subsequently be inoculated with fresh liver containing active Spirochætæ icterohæmorrhagica without fatal results. Horse serum, obtained from horses inoculated with the organism, protected guinea-pigs, and, injected into men, caused immune bodies to appear in their blood; but guinea-pigs into which it has been injected did not develop immune bodies until they had received and had survived injections of living Spirochætæ icterohæmorrhagicæ, a fact which may bear some relation to the greater susceptibility of the guinea-pig. This horse serum was also apparently useful in curing cases of Weil's disease among human beings.

Still another series of studies by the Japanese (Inada *et al.*) determined that serum from immune goats inhibited the disease in all cases if injected before the appearance of jaundice. Thirty-five cases of Weil's disease were treated with serum. Seven deaths occurred, but 1 of these was moribund when admitted, and 2 died of accidental complications, so that the actual mortality was 12.5 per cent; the usual mortality in Japan being 30.6 per cent. It was found that the serum decreased the infectivity of blood drawn on the fourth day of the disease, and absolutely destroyed all the Spirochætæ icterohæmorrhagicæ in the circulation. It was necessary to inject fairly large doses, 60 cc in twenty-four hours. The course of the disease is said not to have been affected, which, I assume, means that the duration of the fever was not shortened. They found that salvarsan was useless (Futaki *et al.*).

In 1915, one year after its discovery in Japan, but before this discovery was known in Europe, Huebener and Reiter discovered

an organism with cilia in the blood of a patient suffering from Weil's disease. It was 5 μ in length and resembled a trypanosome. This organism was pathogenic for guinea-pigs and mildly pathogenic for apes and rabbits. In a later paper they suggested the name Spirochæta nodosa. Doubtless, had they had more material than one human case, they would have studied the organism completely; as it was they merely comfirmed the Japanese workers. They claim, however, that in guinea-pigs, salvarsan, although it does not prevent, at least delays, death.

In 1917 Noguchi, having obtained living organisms from Japan, Belgium and the American wild rat, made a careful study of all. He found that it differed from other spirochetæ in having more twists, in being actively motile for three months in firm agar media, and in resisting 10 per cent saponin solutions. Therefore it should be considered a new species and he suggested the name Leptospira icterohæmorrhagica, and this has been generally adopted. He found also that the leptospiræ from the three sources were probably identical, for they conferred cross-immunity. Inoculated guinea-pigs died in from nine to twelve days and they had jaundice, choluria and extensive visceral hemorrhages. The leptospira were found in the organs, rarely in the blood, and in varying numbers in the urine. Apparently nothing of importance has been added since this paper.

Weils disease is a specific infectious condition caused by the Leptospira icterohæmorrhagica. This organism is found in the wild rat, in many, and probably in all, parts of the world. In Japan it is found in 39.5 per cent in the house and ditch rats, in America, Jobling and Eggstein found it in 10 per cent of the wild rats of Nashville, Tennessee; and Noguchi found it in the rats of Guayaquil and New York. Host and parasite apparently live in perfect amity, for there is no reason to assume, from the reports of the investigators, that the rats are in any way disturbed by the leptospira. The parasites escape by the urine and infect the soil, particularly if it is wet, and the disease may also be communicated by rat-bite, at least two guinea-pigs bitten by infected rats developed the disease. The disease is more common in individuals

working in places infected by rats; thus in Europe and America it occurs especially among butchers, in Japan among cooks and miners.

The symptomatology, as described by various observers, although essentially the same, nevertheless varies in some particulars. Valassapuolo recognizes four stages: First, spontaneous pains in the muscles, dysphagia, erythema and injection of the conjunctivæ. Second, icterus (this he states, in agreement with Dawson, may be absent), oliguria, and in the urine albumin, casts and blood are found, and rising fever. The erythema stops when the jaundice appears. Third, the urinary crisis occurring about the seventh or ninth day, the amount of urine rising to 2 liters per day and even more, exceptionally 8. During this time the fever diminishes. Fourth, the stage of convalescence. The fever is usually remittent, there may be hemorrhage from the nose, gums and into the skin.

Dawson speaks of the initial chill, the pain behind the eyes; the high fever (103° F. to 105° F.) and vomiting in the early stage; the enlarged liver and palpable lymph glands; the rare enlargement of the spleen. Jaundice occurred usually on the fourth day. Hemorrhages occurred in 14 of 18 cases, herpes labialis in 40 per cent of the cases. There is leukocytosis. The pulse is slow. Rare complications are retention of the urine in 3 cases and auricular fibrillation in 1 case.

Gwyn mentions that the onset may be acute or gradual. Chill occurred in only 7 of 13 cases. All cases had prostration, headache, nausea and vomiting, and nearly all had abdominal pains. He lays great stress upon the muscle pains, which he regards as possibly due to myositis, caused by infection of the muscles by the parasites. This should be investigated, for it is an interesting suggestion. The muscles may be swollen as well as tender. He further suggests that myositis without jaundice may be caused by leptospira.

In addition to the jaundice he notes a scarlet flush, herpes labialis, a few rare eruptions, and lays emphasis upon the injection of the conjunctivæ. Delirium, coma and convulsions were noted in a few patients. Hemorrhages were common, but purpura rare.

The liver and spleen were seldom palpable. The urine contained albumin and casts. There was mild leukocytosis. The pulse-rate was usually slow.

These three papers are especially quoted because all are based upon personal contact with the disease.

Basile thinks that the jaundice is hemolytic; Heiser believes that it is obstructive and caused by a plug of mucous in the common bile duct direct. The van den Berg test in my second test agreed with this opinion. Jones and Minot also indirectly support this view, because they find that in the early stage, the duodenal contents contain very little bile and in the latter stage a large amount. Dawson *et al.* state that the leptospira may cause the disease without producing jaundice. The diagnosis should not be difficult. If a patient has fever, jaundice and pain in the muscles the leptospira should be sought, and if it is not found in the blood, by proper methods, it can, if present, be found in the urine.

The treatment is important only in severe cases, and in these the curative serum alone offers any effective remedy. Arsenic and mercury have been suggested, but there is no evidence of their worth.

Prophylaxis is effective. Disinfecting the ground and draining the surface water checked two epidemics in Japan. Any attempt to exterminate rats in this country for the purpose of preventing the occurrence of the disease would be unjustifiable, because it does not constitute any serious menace; but rats carry at least one other spirocheta capable of infecting human beings, Spirochæta morsus muris, causing rat-bite fever, and also the bacillus of bubonic plague; and the economic loss that they cause is tremendous. Therefore leptospirosis may be regarded as an additional reason for a nation-wide effort to exterminate them. It would be interesting to know if mice also carry leptospira, but I have found no information upon this point.

The disease is probably not uncommon. Many cases of catarrhal jaundice may be mild forms of Weil's disease and it is possible that myositis without jaundice and with intestinal manifestations and muscular pains may also be due to the leptospira, for

Dawson's observations cannot be questioned and are supported by Valassopuolo. When suspected, confirmation should be easily obtained. The easiest method, if a well-equipped laboratory is available, is the examination of the blood by dark-field illumination. This, as my first case showed, may be positive as late as the tenth day, but should be done as early as possible. Guinea-pigs are available nearly everywhere in America. In the early stage they may be inoculated with the patient's blood, later with the sediment of the centrifuged urine, collected under conditions as aseptic as possible. The leptospirosis of guinea-pigs is characteristic. An emulsion of the livers of a guinea-pig dying of, or killed during, the disease will infect other guinea-pigs and the leptospira can be maintained indefinitely.

Blumer does not believe leptospirosis is common in the United States. In a very careful study of the history of this condition he notes that 72 per cent of the epidemics occur in the fall, that the disease is mild, common in young persons and that the leptospira is never found. As in his own cases a careful search was made for it by modern methods this statement is of importance but it is so at variance with the work in Japan and elsewhere that, in view of its negative character, it must be accepted, if at all, with great caution. Wadsworth, however, contributes some supporting evidence. In the 300 cases of infectious jaundice studied by his laboratory workers no leptospiræ were found. The conditions were unfavorable, but one of the laboratory workers, inoculating rabbits with virulent leptospiræ obtained from rats, pricked her finger, had atypical attack of Weil's disease and Leptospiræ icterohæmorrhagica were found in the blood.

Leptospirosis icterohæmorrhagica has been found in four continents, Europe, Asia, Africa and North America, from Scandinavia (Lapidus and Flaum) to the tropics, for the rat is universal and the leptospira seems to be everywhere.

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DISCUSSION

Dr. W. Egbert Robertson: It is not very often that an opportunity is given us to see a patient with Weil's disease. Perhaps I am justified in speaking of a case as Weil's disease which I saw several years ago. It did not occur to me until several years later, as a matter of fact, but in looking back and in referring to the postmortem findings, it seems to me that it is so characteristic of the type seen, especially in Japan, that is the type of case which dies within a few days, and dies the death of the uremic. This man came into the Episcopal Hospital at the time I was pathologist there and no diagnosis was made other than jaundice of malignant type. He died apparently of uremia, and at necropsy I found the liver of a type I had never seen before. I had previously posted one case of acute yellow atrophy. The liver of the case which I now regard as Weil's disease resembled acute yellow atrophy in patches. There were in both lobes, but particularly in the right lobe, a number of areas in which histologically the tissue had undergone absolute fatty degeneration, but the demarcations of the cells still remained, and the interstitial framework still persisted, so that it furnished the supporting outline. Then there was another one which was not so typical. She died a somewhat similar death, although her liver did not show such markedly fatty, necrotic areas. I think one of Dr. Sailer's cases must be classed among the rather rare ones in view of the fact that the organism was found by dark-field study of the blood. This I believe is an unusual finding. They have been looked for many times, but seldom found. Theoretically they should be found in the first five days. The classification of these organisms is somewhat interesting. Haeckel places them among the Protista (low unicellular, non-chlorophyl bearing organisms), a group term he gave to a number

of organisms which do not fall definitely into the protozoön or protophyte groups. Several genera of these spirochetes are etiological factors in disease. Noguchi speaks of several of them. The Treponema pallida of syphilis, the Spirocheta recurrextis of relapsing fever, the spirillum of Vincent's angina, Leptospira icteroides of infectious jaundice (Weil's disease) and the Treponema pertenue of yaws. Dr. Sailer referred to the method of differentiation which reminded me of the bile-solubility method often necessary for distinguishing pneumococci from streptococci. Some of the Protista are soluble in alkalies and dilute acid, and others are soluble in 10 per cent Saponin. So that there must be a very marked biological difference in these various organisms, and clinically there is, of course, a marked difference. Two of the above diseases resemble one another rather closely. These are yellow fever and hemolytic or epidemic jaundice, except that in yellow fever there is a characteristic vomit which does not exist in Weil's disease, and it has a seasonal incidence, while epidemic jaundice occurs any time. Syphilitic Icterus gravis also deserves mention. A fair proportion of cases of syphilis in the secondary phase have jaundice, and we know that in some instances the liver of the syphilitic will go on to a yellow atrophy phase, so there are both pathological and clinical resemblances. The course of the malady should enable one to avoid error, but one may see a patient without seeing the initial lesion or even suspecting it, and under these circumstances the jaundice and fever may prove puzzling, and clinically it might be difficult to differentiate. Yaws is largely a cutaneous disease and does not produce the changes so common to syphilis in the vascular system, the various organs or the nervous system. Weil's disease may be more common here than we have been led to suppose, but certainly not in epidemic form; but since the rat is the means by which the disease is transmitted, indirectly, we should suspect any case of jaundice with fever not otherwise explained. Dr. Sailer referred to the rat-bite as being capable of producing the infection. I did not know that there had been any cases of infection from direct bites of rat. Whether the Leptospira can gain entrance through the intact skin I do not know.

Dr. H. S. Halpern: I cannot add much to what Dr. Sailer said about the case. The patient came into the ward and was a very deep yellow hue, in fact so much so that I thought possibly he was a case of pernicious enemia. I went up to him and he said he had very severe pain; I placed my hand on his thighs and he flinched. This pain in the leg was the outstanding feature. I took the catheterized specimen of urine over to the laboratory and injected it into a guinea-pig. The guinea-pig in a few days turned yellow. The sediment of the guinea-pig's urine was yellow and in it

the spirochete was found. Sections of liver and kidney showed similar spirochetæ.

Dr. James M. Anders: I think Dr. Sailer's paper is a very timely one because I believe a great many cases of Weil's disease have been overlooked in recent times. I have not seen any cases since the discovery of the specific cause, but retrospectively I could make a probable diagnosis of Weil's disease in one instance. The late Dr. William Pepper was in the habit of emphasizing the fact in connection with catarrhal jaundice that if fever arose the case at once assumed a serious phase and was no longer to be considered simple catarrhal jaundice. Weil's disease at that time had not been described. The case I saw also occurred before the discovery of the specific spiral-shaped parasite of Weil's disease, so that I cannot be sure that it was an instance of that disease, but I did meet with what Dr. Pepper referred to in his clinical lectures as a case of jaundice with fever. I feel certain, as Dr. Robertson says, that the disease does not occur in epidemic form in this country, and therefore the opportunities for studying it are not very frequent, but of the fact that it is overlooked there can be very little doubt This paper by Dr. Sailer should have a very good effect by calling the attention of the profession to this disease and leading physicians to look for the specific cause wherever they may meet jaundice with fever and particularly in the presence of the other symptoms named, more particularly the pains in the muscles.

Dr. Sailer (closing): There is nothing to add. Concerning the rat bite, two guinea-pigs were exposed to a wild rat, the rat bit them and they developed typical Weil's disease. They both recovered. Obviously the investigators did not care to expose human beings to the bite of rats, and so their experiments were carried no further. It has been suggested that many cases of so-called "catarrhal jaundice" are really cases of Weil's disease. The diagnosis is not very difficult. The first case was an exceptional case, as Dr. Robertson says, the leptospiral not usually being discovered so late in the blood. The diagnosis is made beyond peradventure. It is an interesting fact that I have seen two cases in two years which rather suggests that it may be more common than we have hitherto supposed.

PROCEEDINGS

OF THE

SECTION ON PUBLIC HEALTH AND INDUSTRIAL MEDICINE

MARCH 17, 1924

Dr. Alexander C. Abbott: It is not necessary for me to call to the attention of this audience the position that heart diseases take in both the morbidity and mortality tables of all our large centers of population. If you have not informed yourself on this subject—and doubtless some of you have not—I would strongly recommend that you take up the annual report of some of our large centers of population; I think you will be surprised at the amount of illness and the number of deaths from various manifestations of heart defects. We have assumed an attitude of fatalism in regard to these affections, most of us in the past having thought that little or nothing could be done in the matter. Fortunately, a group of individuals in Philadelphia, with whom perhaps you are better acquainted than I, have banded themselves together for concerted consideration on this question, in the hope of finding out if it is not possible to lessen incidence. We were very fortunate in securing the coöperation of that "Association for the Prevention and Relief of Heart Diseases" in arranging the program for this evening. You will see from the program that all of the papers to be presented are from members of that Association, and it gives me very great pleasure now to introduce Dr. Joseph Sailer, who will address us on "The Growth and Work of the National Association for the Prevention and Relief of Heart Disease."

The Growth and Work of the National Association for the Prevention and Relief of Heart Disease

BY JOSEPH SAILER, M.D.

The problem of the care of those unable to care for themselves has been recognized by society almost since its beginning. It

involves two obligations: First, provision of the means for such care, and, second, the application of these means so that care shall be effective. Of these the first was for a long time practised almost alone. Money, food, clothing or housing was provided and distributed in various ways to those declaring need, but it was gradually perceived that in many cases the needy lacked the ability intelligently to employ the doles given them and the organization of help became a problem of equal importance. We may assume that the first efforts in this direction resulted in the establishing of almshouses, hospitals and asylums. These apparently were established by religious orders, rulers and charitably disposed and usually wealthy individuals, and in some cases by military organizations. Instances of these are the Egyptian priests, the Hindoo king Asoka and the Crusaders. The motives that led to their establishment were doubtless mixed, but the underlying impelling force must have been communal altruism. It is easy to perceive that, in the case of hospitals and asylums, the problems presented by each led to a desire on the part of those entrusted with their conduct to seek solutions, and in this search to achieve greater efficiency. It is, I believe, no great exaggeration to assume that by far the greater part of the general advance of medicine in the past century and a half has been due to the existence of numerous hospitals and group work of the staffs. In all large movements the efforts of those who at various times direct them have been toward personal benefit or increased efficiency. Probably in no public work extending throughout the existence of civilization has the effort to promote efficiency been more constant than in the medical care of the sick. The results are satisfactory. Political methods have made little if any progress and industry has developed as a result of mechanical ingenuity, but medicine advances. The greatest difficulty is that comparison with the past will inspire complacency. Fortunately there is no evidence that this is so. Much dissatisfaction was and is felt with the general hospital care of the sick. It provides for the severe period of disease, but unless convalescence is complete, does nothing to reëstablish the patient. The hospital method of

treating tuberculosis has been almost completely supplanted; it is the first instance of international constructive work.

It seems strange that it was so long before a similar attempt was made for heart disease. That it was made at all was due to the initiative of Dr. Lewis A. Conner, of New York City, a man of clear thought, singularly obstinate when met with discouragement and disappointment. Under his guidance an organization slowly arose that now carries on multifarious activities either directly or through subsidiary or affiliated associations. As in all cases, the problem is much more complex than it appeared that it would be. It has been successful.

Imitators began to appear, first in Philadelphia, then in Boston, Chicago and other places. The movement was growing. Evidently it was useful, and two years ago, under the lead of Dr. Conner, a meeting was held at St. Louis to create a national association. This has proceeded slowly. It is not necessary to magnify the difficulties. At present we are about to incorporate, and the object of the association, as set forth in the articles of incorporation, state our hopes so clearly that I cannot do better than quote them:

CERTIFICATE OF INCORPORATION

UNDER THE PROVISIONS OF CHAPTER 40 OF THE LAWS OF 1909 OF THE STATE OF NEW YORK, KNOWN AS THE MEMBERSHIP CORPORATIONS LAW AND THE ACTS SUPPLEMENT THERETO AND AMENDATORY THEREOF, OF AMERICAN HEART ASSOCIATION, INC.

Know all men by these presents, that we, Paul D. White, Joseph Sailer, Hugh McCulloch, Robert B. Preble, Robert H. Halsey and Lewis A. Conner, all of whom are persons of full age and at least two-thirds of whom are citizens of the United States, and at least one of whom is a resident of the State of New York, being desirous of becoming a membership corporation under the provisions of Chapter 40 of the Laws of 1909 of the State of New York, known as the Membership Corporations Law and the acts supplemental thereto and amendatory thereof,

Do here certify as follows: First. The name of the corporation is to be *American Heart Association, Inc.*

Second. The particular objects and purposes for which it is to be formed are the study and the dissemination and application of knowledge

concerning the causes, treatment and prevention of heart disease; the gathering of information on heart disease; the development and application of measures that will prevent heart disease; the seeking and provision of occupations suitable for heart disease patients; the promotion of the establishment of special dispensary classes for heart disease patients; the extension of opportunities for adequate care of cardiac convalescents; the promotion of permanent institutional care for such cardiac patients as are hopeless or incapacitated for self-support and the encouragement and establishment of local associations with similar objects throughout the United States.

Third. The territory in which its operations are to be principally conducted is the United States of America.

Fourth. Its principal office is to be located in the borough of Manhattan, City, County and State of New York.

Fifth. The number of its directors or governors is to be fifteen.

Sixth. The names and places of residence of the persons to be its directors or governors until its first annual meeting are:

Joseph Sailer, 250 South 18th Street, Philadelphia, Pa.
George W. Norris, 1820 South Rittenhouse Square, Philadelphia, Pa.
William D. Stroud, 1011 Clinton Street, Philadelphia, Pa.
Hugh McCulloch, 500 Kingshighway, St. Louis, Mo.
James B. Herrick, 122 South Michigan Avenue, Chicago, Ill.
Robert B. Preble, 30 North Michigan Avenue, Chicago, Ill.
Sidney Strauss, 104 South Michigan Avenue, Chicago, Ill.
Charles J. McIntyre, 305 West 40th Street, Indianapolis, Ind.
Paul D. White, Massachusetts General Hospital, Boston, Mass.
Henry Jackson, 380 Marlboro Street, Boston, Mass.
William H. Robey, Jr., 202 Commonwealth Avenue, Boston, Mass.
Haven Emerson, 120 East 62d Street, New York City.

I should like to explain the objects of this work:

They are: First, the care of those who need it. All progress in work for the sick has been initiated by the medical profession, and it is clear that if they do not undertake it no one else will. Heart disease in any form is a handicap and therefore all suffering from it need care. If they are destitute or poor, it is our duty to supply this care in whatever form may be required.

Second. To promote efficiency and economy in the management of heart cases. If a man or woman previously unable to work can be rendered self-supporting or partially self-supporting,

or one on the edge of a decompensation can be supervised and the breakdown prevented, not only the patient but the community benefits; but of more value is the restoration to the individual of self-confidence.

Third. To diminish the incidence of heart disease, not as hopeless a task as at first sight it would appear to be.

Fourth. To prolong the life of those with damaged hearts. As physicians we have no choice. The fundamental objects of medicine are to restore health, to prolong life and to relieve suffering.

It must be apparent that this is only a beginning. Tuberculosis, heart disease, cripples and the blind are being helped by well-managed and in some cases wealthy organizations, but they comprise but a small part of those who need it. What is needed is a national association for the prevention and relief of disease, covering the whole United States, with separate departments for each special form of work, but all coöperating until all those handicapped by sickness or injury, who cannot care for themselves or who cannot be cared for by their relations, may be assured that every resource known or to be learned will be used either to make them again useful members of society or to secure for them the utmost possible comfort and happiness.

The Organization and Results of the Cardiac Clinic

BY JAMES E. TALLEY, M.D.

The existence of the special clinic needs no defence, but this fact may not be admitted by all. We may, with advantage, consider the advances in medicine that have come to us practically within my medical lifetime—advances so numerous that to study, understand and apply them practically in the whole domain of medicine has become an impossibility for the individual doctor. For this broadened knowledge, with its accompanying burden,

we have to thank savant, scientist, clinician, old-time professor and clinical professor of medicine, and more recently the full-time professor. Professor Richet, in his interesting book, *Le Savant,* has described the savant as a searcher after truth. He was an originator, he was an enthusiast, he was simple, patient, sincere, persistent and self-denying. The discovery of a general law, an unexpected or hitherto undiscovered relation, was as a nugget of gold to him, but he was indifferent to its practical application. You would expect the American savant to have a practical side because of the conditions under which the American people have developed. Furthermore, the study of medical problems leads at once to a practical application. Pasteur's work had its everyday touch—the study of the fermentations in wine and beer, the diseases of the silkworm, glanders, rabies and puerperal fever. Let this fact suffice for an example of the persistence of the savant or scientist, as you will, that Pasteur had a slight apoplectic stroke at forty-eight, so that for the rest of his life his left leg dragged a little—another instance of the fact that some of the best work of the world is done by men whose health is substandard according to the actuarial tables. For in his lifetime he gave medicine and surgery as much as if not more than all the erudite medical men in the centuries preceding him. He was no fundamentalist.

But the savant, as well as other men, must live, and until recently a professorship was the only opening for him. This naturally interfered with his research work. Leidy was a savant turned professor. Richet bemoans the fact that in the Old World there are few foundations granting a living wage to the savant. In America we are more fortunate in having the Rockefeller Institute, the various chairs in research medicine and other foundations and grants for scientific research. Again, the full-time professor is on trial. With lectures, clinics, conferences, the conduct of his department and keeping abreast of medical literature, his day is full. Even so, his lot is easy compared with that of the professor of the old school, who, in addition, carried on a large practice. Agnew, Gross, Pepper, Musser, Da Costa were of this older school, and they assuredly had need of the brain

and brawn, if not the other B of Palmerston. It is interesting to contrast in one's mind their lot with that of savants in medicine—Osler at Oxford, Allbutt at Cambridge and Janeway at Johns Hopkins. But all of them, savant, scientist, old-time practitioner and professor and full-time professor, have added to our inheritance of medical knowledge. Within the medical lifetime of some of us here present there have been added bacteriology, immunity with serotherapy, biochemistry, the products of synthetic chemistry, calorimetry, the *x*-ray, radium, electrocardiography and antiseptic and aseptic surgery. This expansion of medical knowledge led to specialization. Neurology, dermatology, pediatrics, tuberculosis, gastrointestinal disease, orthopedic surgery, genito-urinary disease, with syphilis, gynecology, nose, throat and ear disease and radiology, long ago became separate specialties, not without a pang to many older practitioners at that time, but no doubt with benefit to the patient. More recently our broadened knowledge concerning thyroid disease, diabetes (already one hundred pages on insulin alone in Joslin's new edition), heart disease, arthritis, blood diseases, asthma and kidney disease call for special clinics also. We must meet these new demands in the spirit of Lewis and Sampson. The former, in speaking of electrocardiography, says: "It has done its share in increasing the already overweighted burden of general medicine. We may not deplore but should welcome the fulness of this load, recognizing in it an increase of our capacity." The latter dedicates his work on physiotherapy to the "Therapeutic Peptimist," and then defines a peptimist as "an optimist who envisions much better things than are even now possible and has the determination, courage, energy and ability to go out and make his vision come true." As Henry Adams says, "We live in the day of the dynamo and not of the Virgin." Whether this increased knowledge is for the weal or woe of mankind depends on the use made of it.

If we are to have these special clinics the question naturally arises, What is to be the fate of the general medical clinic in the end? The uniform answer from all those with whom I have talked has been that it will be a diagnostic clinic. Under such conditions

the position of the out-patient physician will, to my mind, be improved. He will take his turn in the diagnostic clinic, where his work will be lightened by the social service department and by the director of the out-patient department, a new official who is becoming more common. Better still, he will be able to conduct or work in one of the special clinics, where he will see enough patients with a given disease to concentrate his study and draw some inferences. Furthermore, he will have the benefit of having had these patients studied in the various special clinics to which he may wish to refer them. For coördination and coöperation must be the watchwords in this work. He may also work in different special clinics and become a good general internist.

Having tried to show the need of special clinics and considered their influence on the general medical clinic, we may pass to the organization of the cardiac clinic. The first requisite is a chief of clinic who has an interest in the clinic and sufficient time to give to it. He should be an internist or a pediatrician with experience in modern cardiology, and the wider his general clinical experience the better. He should have full charge of the clinic, should supervise the work of the juniors and should be finally responsible for diagnosis and treatment. It has been estimated that he should have at least one assistant for every fifty patients. Any special clinic will fail in which a full history of the patient is not taken and a thorough physical examination made. If each physician takes more than two new patients in an hour he will probably find much to be added at subsequent visits. Again, he must be a rapid and accurate worker who will get through ten returned patients in an hour, as suggested in some clinics.

A cardiac clinic to be successful must have the coöperation of a social service department. A social service worker must have charge of appointments, of admissions and of distribution of patients. The social service department must be the connecting link between the heart clinic and the home, the hospital ward, the convalescent home, the school, the dentist, the nose and throat department, the general laboratory, the *x*-ray department, sometimes also the diet kitchen, the department of physiotherapy,

occupational therapy and associations for placing patients in suitable positions. They alone have means of knowing the family conditions and can often secure permission for proper medical and surgical treatment where we may fail. The partial filling in of histories by the social service workers when they have time before the patient comes to the doctor is a great time-saver, and the collection and filing of the history and the records from various departments is of inestimable value. There should be a nurse in attendance at the clinic to take temperatures, to weigh patients and to prepare them for examination.

The necessary space is a waiting-room and a number of small rooms or cubicles in which to take histories and examine patients. Each of these small rooms should contain an examining-table or couch and a small desk and chairs. It facilitates work to have on each physician's desk a blood-pressure apparatus, a millimeter rule, a reflex hammer, tongue depressors and blanks for referring patients to other departments or other institutions. Small flashlights and instruments for examining nose, throat and ear are desirable. Each clinic should contain one spirometer. Each physician usually has his own stethoscope.

With respect to records the Cohn history sheet is ideal, but the universal difficulty of securing enough workers has so far precluded its wide use. Most clinics have to content themselves with less complete records. Many clinics have worked out satisfactory forms which include history, physical examination, laboratory findings, treatment, progress of the patient and social service activities. All records pertaining to each patient should be filed in one folder.

A cardiac clinic should be an integral part of the out-patient department and should have the facilities of the *x*-ray department and the clinical laboratory, including Wassermann tests, blood chemistry and basal metabolism findings. It should have the coöperation of the special clinics and should offer its assistance to them. The heart clinic should also have the facilities afforded by an electrocardiograph department, although the absence of this department should not prevent the formation of a heart

clinic in communities where there is a demand for it. A chief of clinic trained in modern cardiology can conduct a satisfactory clinic without it, especially if he can refer selected cases to another heart station. If one has time and aptitude to master the polygraph it will afford valuable information concerning alternation, conduction and the various irregularities, but it lacks the exactness of the electrocardiograph.

In figuring on a heart station, one should include the salary of at least a part-time technician, for there is so much routine that it becomes a nightmare to the already overloaded doctor. The chief of clinic should have ward privileges, so that he can admit for preliminary examination and treatment patients originating in the clinic whose condition requires hospitalization. The assistants should be encouraged to follow the progress of such patients, as it tends to hold their interest. In return the heart clinic should care for cardiac patients dismissed from the wards. Thus visiting physician and chief of clinic have a common interest and their amicable coöperation has already been demonstrated in various hospitals. The results of the cardiovascular examination, as well as the findings in other special departments, are available to the visiting physician for use in teaching.

The duties of the medical staff of the cardiac clinic should be limited to diagnosis and treatment, the executive part of the work being carried on by the social service workers, who have standardized their own activities. It is highly desirable that the interne on duty in the medical ward should work in the cardiac clinic, where he will see cardiac disease in its incipient stages when amenable to treatment rather than in the terminal stages in the wards. The classes of patients retained in the cardiac clinic should be those with organic heart disease and those with potential heart disease. Many doubtful cases will have to be carried until their diagnosis is established. In general, each patient should be continuously treated by the same physician. Once enrolled in the cardiac clinic he should report by appointment, though free from symptoms, and should feel free to report at any time when new symptoms or signs arise. No patient should be com-

pelled to return to the hospital at short intervals for medicine alone. Any patient who does not report in six months, especially when requested to do so by postal card, should be considered discharged. Anyone interested in the formation of a cardiac clinic should avail himself of the report formulated on this subject by the New York Committee on Cardiac Clinics.

In the three years since the establishment of the first cardiac clinic in Philadelphia their number has increased to twenty, with an approximate attendance today of 2800 patients. Each patient has had a thorough general physical examination and an intensive study of his condition from a cardiovascular standpoint. He has found a center where he has received continuous supervision and treatment by one versed in this special line of work, and many a cardiac breakdown has been forestalled. This careful study of his condition and his association with a number of people all striving for the same end have assured his regular attendance, which is a factor in keeping him fit. He has had a survey of his home conditions and of his work, and where necessary an attempt has been made to find him a position adapted to his powers. The work of the cardiac clinic has been a factor in revealing the large number of persons suffering from cardiac disease and in interesting the community in its prevention. The economic waste of probably preventable cardiac breakdown in patients requiring repeated hospitalization is sinking into the minds of the medical profession and of the laity. The realization of the need of a large number of convalescent beds for the prolonged care of cardiac patients is due, partly at least, to the cardiac clinic. It has afforded a center where many physicians have been able to see and participate in the modern diagnosis and treatment of cardiac patients, and it has led to an increasing standardization of diagnosis and treatment which has been good for both physician and patient. This bringing together of great numbers of people with a common complaint will in time afford a mass of data which will be useful in the study of the etiology, the diagnosis, the prognosis and the prevention and treatment of cardiac disease. When we remember what has been accomplished in one lifetime in the prevention of tuberculosis,

diphtheria, yellow fever, malaria, hookworm, typhoid and the summer gastroenteritis of children, is it not worth while to strive for similar results in cardiac disease?

The Standardization of the Diagnosis and Treatment of Heart Disease in Cardiac Clinics

BY THOMAS MC MILLAN, M.D.

When I came to consider what I would say on the subject assigned to me, "The Standardization of the Diagnosis and Treatment of Heart Disease in Cardiac Clinics," the lines of thought that occurred to me as being most worth considering were, first, the advantages that might accrue from standardized methods, and, second, if uniform methods were worth while, how could they best be put into effect?

As to the first. What are the reasons for our adopting uniform methods of study? We believe there are some very definite reasons why a uniform and systematized method of studying heart disease is highly desirable.

It will be possible tonight to point out but a few of the advantages of standardized methods over haphazard individual procedures.

The first reason, the most attractive and perhaps the most important, is allied with the fact that those of us who are seeing many cases of heart disease are in a sense investigators, in that we are observing and dealing with great unknown questions, the answer to which is fundamental to an ultimate understanding of heart disease and to the development of a rational treatment of this great problem. There could be no more fascinating field for clinical investigation than cardiology, for the reason that each case that comes to us presents most emphatically these great unanswered problems:

Hypertrophy. What is it? What brings it about? We must admit that we know little or nothing about the cause of the single most important physical sign in heart disease.

Dilatation. The beautiful work of Starling has shown that the longer the muscle fiber or, in other words, the greater the heart is dilated up to a limit the stronger the contraction. He has shown that this mechanism is the chief way in which the normal heart gains needed strength to do increased work. Now, clinically, we have no method even of recognizing dilatation, much less of studying Starling's work in its relation to the diseased human heart.

The Coronaries. We know practically nothing of the physiology or control of this, the most important single unit of the circulation. I point out these three subjects not because they are the most important problems of heart disease, but simply because they occurred to me as random thoughts. I might have included heart failure, for we know little or nothing about it.

And so on *ad infinitum.* There are hundreds of questions that are yet unanswered. The point I wish to make is that many of these unknown facts will become clear if the competent men and women who are attending heart clinics and seeing heart cases will all tackle these questions. If we all work to the same end and use uniform, standardized methods of diagnosis and study and treatment there will soon accumulate a mass of reliable data and statistics that will answer many of these questions. The nature of many of these problems is such that they will be answered by the clinical investigator and not by the laboratory physiologist.

There is just one other question that I wish to stress. I wish to emphasize it because it lends itself peculiarly to clinical investigation. I refer to cardiac infection. The great mass of heart disease results from infection, chiefly the so-called rheumatic group, tonsillitis, chorea and rheumatic fever. As a working basis we believe that these infections gain entrance to the heart through the tonsils. It is certainly a fact that one attack of rheumatic fever is often followed by other attacks. The work of St. Lawrence indicates strongly that the removal of tonsils (and other foci of infection) after a first attack of rheumatic fever or chorea will prevent a recurrence. And, furthermore, that removal of diseased tonsils, etc., before an attack of rheumatic fever will prevent the occurrence of this catastrophe. Now, this is splendid if it is

so; but, ladies and gentlemen, we are scientists, and, after all, this theory, while attractive, is based on but a few cases relatively. Before we can be certain of its efficacy it must be applied to series after series. Just within the last week there has been published a series of cases in which an attempt was made to repeat St. Lawrence's work. In this series, very unfortunately, there were almost as many recurrences of rheumatic fever in those cases with tonsillectomies as in those on whom this operation had not been performed. Let us pray to God that St. Lawrence is right, for in the system of treatment based on his observations lies our greatest hope. If true, we can actually *prevent* heart disease. If not, we must flounder on, helpless as yet to cope with this great menace.

But the point that my paper should emphasize is the advantage of all of us adopting some standardized technic for dealing with infection. The technic in principle is to remove all foci of infection. After chorea and rheumatic fever remove all tonsils whether they show clinically evidence of infection or not. The advantage is that—if our theory of the relation of the tonsils to the rheumatic infections is correct, this procedure will do incalculable good. If our theory is incorrect we will do no harm, but we will accumulate sufficient data to eventually learn for all time if we have a great weapon or if we are on a false trail.

I can indicate my meaning as to the importance of unified standardized methods of study by an analogy. In the four years of the World War more was learned about heart disease than centuries of haphazard individual study previously had yielded. The reason was that large numbers of cases were being studied by trained persons, and the various units of this system worked as a systematized, standardized whole, using standard methods. Now, I believe that this movement against heart disease, as it has been organized here, can accomplish, on a smaller scale of course, the same sort of thing that was accomplished during the war. Many of these problems must be answered in the laboratory, but others will be answered by careful clinical study and application.

I have stressed this point because it appeals to my imagination and makes this movement such a valuable scientific instrument.

You must have gained some idea of the plans and scope of the work as it has been outlined.

You have heard of the organization of the individual clinics and you have been told of some of the opportunities that can be given by a large association that the individual hospital clinic cannot furnish—convalescent care, occupational therapy, vocational training, etc. Now, all this requires organization and great coöperation. I think you can see at a glance, without my dwelling upon it, that it is essential that each individual case be tagged with some comprehensive diagnosis that will at once express to persons unfamiliar with the case an idea of the condition of the patient. This is necessary merely for expediency and efficiency.

Now, as the diagnostic plan has been laid out by our association, all our diagnostic studies are to culminate in the placing of each case in one of the five classes: Class I, Class II, Class III, Class IV and Class V.

Now, this classification is a remarkable one. It is hard to use, but the difficulty of the classification is the difficulty of careful cardiac diagnosis. It is easy to hear a systolic murmur and say mitral insufficiency, but that is not diagnosis! The beauty of this classification, the fact that makes it remarkable, is that, for the first time, so far as I am aware, we have a classification based on the condition and functional state of the heart muscle. There is no mention in this classification of murmurs or valve lesions or etiology. When we have placed a person according to this classification we have attempted to judge the state of that heart by the only criterion that matters one whit, and that is the amount of damage that has occurred in the muscle of that heart. This classification is admittedly imperfect; but merely for efficiency, if for no other reason, if the advantages offered by the Association are to be used in their full abundance, the various units—the individual clinics—must use the same diagnostic classification. Let us all use the best and most rational classification that is available.

Time will not permit us to go into the details of the studies on which our final opinions are based. Suffice it to say that the organizers of this movement against heart disease have outlined what

they think are the most important observations and studies that should be made. The most elaborate are comprised in the form of a diagnosis sheet gotten out by Cohn, in New York. As a matter of fact, some of us have modified this somewhat. I am going to pass around the sheet used by the two clinics that I am associated with, that at the Pennsylvania Hospital and that at the Philadelphia General Hospital. Both these are similar in all essential points to the charts of Cohn. After using these for three years we find that they serve our purpose as well as any short chart could. Only time and trial will tell us which is the most perfect form. When this is worked out then we hope that all clinics will adopt some form that is identical in size and wording. The other advantage of standardization that I wish to point out is the fact that the standardized methods that are recommended have been gotten together by men who have given years of study, thought and investigation to the problems of heart disease. If experience and thought are worth anything the fruit of their years of observation should be the best.

I have attempted to show, in a most sketchy and halting way, some of the advantages of uniform methods of studying heart disease. I can see no possible objection to this intensive method of attack. On the contrary, every consideration, it seems to me, urges it. If, therefore, it is advisable to standardize our methods, how in general terms can this be brought about? To do this all workers must accept certain facts as fundamental. We must all make the same studies, and then we must all interpret these findings in the same light. It will avail but little if one of us interprets a systolic murmur as definite evidence of valvular damage while another demands much more proof before admitting a damaged heart. This means that we must revise many teachings that were accepted as recently as ten years ago. The whole foundation of modern cardiology is based on the conception that heart disease and heart failure result from damaged heart muscle, and that the damage in the great majority of instances comes from infection. To standardize our work this is the fundamental and basic fact on which all our diagnosis and methods of treatment must be based.

This conception does not in any way minimize the importance of diagnosing valve lesions. This is most important, for the presence of valve lesions is almost pathognomonic of muscle damage. The point to emphasize is the importance of interpreting valve lesions in this light rather than in the light of a mere added mechanical impediment.

There is but one other physical sign that I can touch on, that is enlargement of the heart, far the most valuable of all physical signs. As a working basis we can say that every heart whose muscle is damaged will show enlargement. There is strong evidence that the converse of this is true as well. Of all physical signs this is the most important for us to carefully determine. Our clinical methods of determining this are faulty and even our instrumental methods are at times misleading, yet we fail to demonstrate this finding when it is present but relatively few times.

If we accept this so-called muscle theory the recognition of a diminished reserve power to meet the increased demands on the circulation is one of our most important ways of recognizing cardiac damage. This diminished reserve must be appreciated in two ways: From the history and from the evidence we obtain from observing the response to some exercise test. We unfortunately have no entirely satisfactory test for diminished cardiac reserve. Some day possibly we will. The many other interesting and important findings we cannot take up in detail, but they all point to and are to be interpreted as evidence for or against myocardial damage.

As to treatment, all modern methods of therapy which are the methods recommended by this association are based on the conception of a diseased heart muscle, and the belief that in the majority of cases this muscle disease results from infection. The treatment of actual heart failure is designed to restore and replenish the exhausted reserve. The treatment of cases without actual failure is designed to protect and conserve this precious power. By standardization of the treatment of heart disease we advocate adherance only to these general principles. There is so much uncertainty as to the value of drugs as well as many other procedures in

cardiac therapy that there cannot be worked out as yet any very systematic fixed system of treatment except as it applies to infection. Dr. Stroud, I hope, will take up in more detail this phase along with the closely allied matter of convalescent care.

I wish we had time to consider other phases of treatment. The mental attitude, the discouragement and despondence that so often result must be considered. We can obtain here most striking results and that is what we are doing in our clinics by our interest and attention, by our social work and by our occupational therapy. If we accomplished nothing in treating the heart disease these clinics would justify themselves by the greater happiness and content they bring to the sufferers from heart disease.

I have tried to point out that uniform standardized methods of study if applied by the various cardiac clinics in Philadelphia would result in the accumulation of reliable statistics that would throw light on many of the as yet unsolved problems of heart disease. I pointed out that if the advantages of the association were to be used in their fullest it was necessary that standard diagnosis should be made and that the recommended diagnoses were based on a consideration of the functioning ability of the heart muscle. I tried to point out that the treatment of heart disease was a difficult thing to standardize, but that the treatment used, as is the case with diagnosis, should be based on the conception that it is disease of the muscle that must be treated. We can as yet recommend no absolute inelastic system of treatment except in so far as it applied to infection. In this case we do recommend a very definite technic.

Convalescent Care of Heart Disease

BY WILLIAM D. STROUD, B.S., M.D.

Although it would seem that all that could possibly be said this evening about the prevention and relief of heart disease had been

said, yet I feel there is still something worth while to say concerning one of the most important parts of the work. Cardiac convalescence is becoming a definitely scientific work, just as it is for tuberculosis. Quotations are used freely in this paper from the reports of the New York Association for the Prevention and Relief of Heart Disease. Their work was begun because of "the large class of patients, especially workingmen with valvular disease, who were being discharged from the hospitals, convalescing from a temporary breakdown of their heart balance. In many instances the direct cause of this breakdown had been the laborious character of the work engaged in and the two essentials for the preservation of their regained health—prolonged convalescent care and the opportunity to secure work of a less exacting sort—were nowhere to be found. Convalescent homes, almost without exception, discriminated against such patients, and the men, after a few futile efforts to find some remunerative 'light work,' usually returned to their original occupations, their one known means of livelihood, trusting that they might in some way escape the later and more serious breakdown against which they had been warned. The number of such patients was so large and the preventable waste of health and life so flagrant as to arouse the sympathies and the concern of the physicians and social service workers of the various hospitals."

Hence the development of the New York Heart Association, and, following its lead, others throughout the country. Where heart associations thrive heart clinics develop, and as convalescent care for the patients in these heart clinics and in the hospital wards is essential, the necessity for homes, where such care may be properly given, arises. The one most important point in convalescent care is the proper distribution of each type of case in homes which are properly equipped to handle them. Cases hopelessly ill with advanced heart failure, or with acutely active endocarditis, causing a marked elevation of the temperature, are not cases for convalescent homes but for the hospital. Again quoting from the report of the New York Heart Association: "There are probably no

patients for whom a prolonged rest under proper supervision is more necessary than those who may be grouped as 'potential cardiacs,' and those who present the 'earliest evidences of organic heart disease.' These are seen in large numbers in the general hospital and in the cardiac clinics. They have had acute rheumatism, 'growing pains,' recurrent attacks of tonsillitis, 'St. Vitus' dance,' etc. They may or may not show positive evidences of damage to the heart. If these patients can be placed in institutions, where for weeks or months their mode of life can be suitably regulated, a very large number will be prevented from ever becoming subjects of heart disease. Some with real heart defects will entirely recover, and in a great many the progressing heart trouble may be so arrested that they will return to the ordinary life of the community, subject only to minor limitations. This statement is based on results obtained from such institutions as the Burke Foundation, which has cared for over 2000 selected cardiacs in the past six years. Of 130 boys between ten and sixteen years of age received during the first two years, 85 per cent have remained steadily at work or at school since leaving the institution."

Our Children's Heart Hospital, situated on the grounds of the Children's Hospital of Philadelphia, at Wynnefield, was founded to meet the needs of the type of case above described and to give them the rest and attention which they so urgently require. Proper care at this time means everything for their future. If these children do not receive proper care serious damage to the heart almost always results, and they become cardiac invalids, incapable of carrying on the ordinary duties of life, and die, sooner or later, from chronic heart disease.

To quote Hirschfelder: "The vegetations are due to the lodging of emboli of the agglutinated cocci within the valves, and are best produced when the valves are most vascular. A fibrinous exudate is poured out with rapidity and areas of necrosis develop and are walled off with leukocytes. Later these give place to the fibroblasts and plasma cells of chronic inflammation, which in turn are

replaced by strands of newly-formed connective tissue which push out into the exudate and finally replace it altogether, leaving a solid vegetation composed entirely of fibrous tissue. With a growth of connective tissue, bloodvessels penetrate into the vegetation, entering it from the subendocardial layers of the myocardium just as they enter sclerotic patches in arteriosclerosis. As healing becomes complete the endothelial layer of intima slowly grows in from the periphery and gradually covers the entire vegetation. This relining of the vegetation with endothelium is, from a prognostic standpoint, a most important step in the healing."

It is our object to keep these children as quiet as possible while this process is going on and until this protective layer of endocardium has had a chance to completely cover the vegetations, with the hope that a recurrence of the active condition may be prevented. Of course, the fibrosis with stenosis of the valves and shortening of the chordæ tendinæ will proceed in spite of rest, but we feel that the less active the exercise which these children take the less the extent of this fibrotic change will be. Of course, this is merely hypothesis, but there seems no other probable explanation for the splendid results obtained, at the Brookline Children's Hospital, in the prevention of extensive damage to the valves following acute endocarditis, by prolonged rest in bed of from six to eighteen months.

Our greatest handicaps are, at present, that the wrong type of case is sent, and that when the correct type is sent, not sufficient and accurate data accompany it. This is part of the program of education which our association hopes to carry out by careful follow-up of cases on which we have accurate data, and therefore the following requirements have been laid down for admission to the home from the data upon which the work was begun:

First. The child must have, or be suspected of having, a damaged heart.

Second. The child shall be over two years of age. If a girl, thirteen years or younger, and if a boy, twelve years or younger.

Third. The child shall have been in the wards of a hospital

for at least two weeks before coming to the home, and the parents shall be made to understand that the child is to remain in the convalescent home for at least four weeks, or longer, if the physician in charge thinks it necessary.

Fourth. That all foci of infection shall have been *completely* removed, such as tonsils, teeth, etc.

Fifth. That no child with actual heart failure, and if possible none whose heart will fail if given proper convalescent care, shall be sent to the home.

Sixth. A complete social and medical history of the case shall accompany the child.

We believe we have definitely confirmed the following points:

1. That children needing convalescent cardiac care must be divided into definite classes, and that those in each class should be given such care in definitely different types of convalescent homes in order to obtain the best results.

2. That before admission all children shall have had careful investigation for possible foci of infection, and these foci removed. The best manner in which to accomplish this is to demand at least a two weeks' stay in a hospital before admission to the home.

3. That if the above requirements have been carefully carried out, prolonged rest in bed, with a gradual increase in effort as the temperature, gain in nutrition and general improvement warrant, will not only greatly lessen the possibility of a reactivation of an endocarditis, but a recurrence of the original etiological factor as well.

Therefore, let us urge that all cases which have had acute rheumatic fever, *i. e.*, inflammatory rheumatism; chorea, *i. e.*, St. Vitus' dance, frequent attacks of tonsillitis (especially in children), "growing pains" or scarlet fever, see a physician for careful examination of the heart. Let us be frankly optimistic toward all those who have heart disease in childhood or middle age, reminding them, with proper care, it need not limit their life nor its usefulness; for what Dr. Trudeau said of tuberculosis is even more true of heart disease: "I may die with tuberculosis, but not from it."

Finally, let those of us who are physicians not shirk our responsibility. As Sir William Osler said: "We must be helpful and tolerant of the fellow-members of our guild; that those who before have not had the opportunity may now see the light."

These little children in our clinics and our convalescent homes do not know what lies before them. It is the duty and privilege of each one of us to see that they have a chance to live happy and useful lives.

DISCUSSION ON THE PAPERS OF DRS. SAILER, TALLEY, McMILLAN AND STROUD

Dr. James M. Anders: I rise to confirm what Dr. Abbott said concerning the group of papers to which we have listened, but I did not come here to participate in the discussion. However, reference was made to the medical social worker, and I was very glad to see the fact brought out that the social worker has perhaps the most important field of work to perform in connection with these heart clinics. The data which the medical social workers collect, the information which they gather at the home and from the various specialists and laboratories is so important that it should be an invariable rule to place their findings in the same folder with the medical history for permanent preservation. You say, "Well, this is being done at present." I happen to know that at least not many years ago the data collected by the social service workers in connection with hospitals and dispensaries was separately filed and very little attention given to it. Happily the advanced clinics are beginning to appreciate the supreme importance of a complete staff of social service workers, and I hope and believe that most of the cardiac data which they gather today is filed away in the same folder with the medical history. I was very much interested in hearing Dr. Sailer detail the history of the National Association that is in process of formation, and yet as I listened to him it occurred to me that after all the principal or constructive work will be done by groups of workers in the larger centers where facilities are adequate. Of course, the national body will get reports from these various centers for comparison and will profit by the experience and activities of these individual centers. I would like to refer briefly to what was said with regard to tonsils. It seems to me that it is going a little too far to say that in all instances in which there has been a case of rheumatic fever or tonsillitis that the principal focus of infection, presumably the

tonsils, should be removed, whether they show any evidence of disease or not. Now in a time such as we are passing through, when thousands of tonsillectomies are performed daily over the country, would it not be possible to get sufficient statistical evidence as to whether tonsillectomy does prevent a recurrence of rheumatic fever or does protect against cardiac conditions without attacking tonsils which show no gross lesions, or must we remove healthful tonsils in order to settle this important question? It seems to me that St. Lawrence's statistics, which have been quoted here tonight, have been already pretty definitely refuted by others. For example, Dr. McMillan referred to one author who found that there were almost as many recurrences of rheumatism following tonsillectomy as in the cases in which tonsillectomy had not been done. I think this is a very significant fact, and we should study, or at least we should first decide, whether the removal of diseased tonsils tends to limit or prevent recurrences of rheumatism and cardiac infection, and if it cannot be decided in this manner, then and then only should we go so far as to remove all apparently healthful tonsils to help us decide this important question. I only throw out this feeling as I do think that the almost universal vogue to remove tonsils on slight provocation has been overdone, and I am not one of those who feel that no harm ever comes from the removal of tonsils. I saw only today a middle-aged person whose tonsils had been removed a couple of weeks ago, and who has been a physical wreck since then, and is, to my mind, in a hopeless condition from lost compensation. The man had had an extremely high blood-pressure and chronic interstitial nephritis, and such a case may develop in a comparatively young person. I was very much pleased with the classification placed on the board. I believe that is the proper way in which to approach the subject of the study of cardiac conditions and to determine the extent to which the heart has been damaged. The reader of the last paper is to be congratulated on the results obtained during the last eighteen months as the result principally of rest and correct feeding. I was very much impressed a couple of years ago when Dr. Conner, of New York, was with us, and he related what they had accomplished in their cardiac convalescent home. I am much pleased to learn that we have an institution at home which is doing similar work with encouraging success.

Dr. R. Max Goepp: It would seem to be appropriate to point out that in the management of heart cases we have one of the best illustrations of the value of periodic examination of the apparently well, a movement which we are all being urged to further at the present time. Thus when patients—I am speaking now of private practice—are told that their hearts are normal they usually take for granted that conditions will

remain normal for the rest of their lives; and even those who are in the state which Dr. Stroud has called potential cases of heart disease, when they are told they have nothing to worry about, although there may be a slight murmur, are likely to go away with the idea that they need give no further thought to the matter. The periodical examination of these potential cases is, I think, almost more important than periodical examinations of those suffering from any other kind of ailment. This brings up another thought I have often wanted to express, namely, the freedom or even recklessness with which young individuals, particularly in industrial work, are rejected for employment on account of slight cardiac abnormalities. This applies both to the ordinary case of possibly harmless cardiac murmur and to cases of mild hyperthyroidism with slight cardiac involvement. While an inexperienced examiner who is doing the routine work of industrial examination might be authorized to accept applicants on his own responsibility, the case of any applicant who is found defective should, I think, be revised by some more experienced examiner before being definitely rejected. It must be remembered that these industrial examinations, like life insurance examinations, remain permanently on record and follow the rejected applicant wherever he goes to seek employment.

Dr. Herman B. Allyn: I would like to suggest that we should give more attention to infections as a class in the causation of heart disease and less to rheumatic fever. Judged by my own experience, rheumatic fever is one of the rarest diseases; yet heart disease is exceedingly common. I think we assign too much importance to rheumatic fever as its origin. Other infections, particularly tonsillitis and sore throats, should go before rheumatic fever as frequent precursors of heart disease.

Dr. George W. Norris: There is only one point which I think deserves a little more stressing than it has generally received tonight, and that is in regard to general education. We have not only the medical profession to educate regarding certain new points in regard to heart disease, but we have the great American public to educate. Fifteen or twenty years ago, when a lot of us started out to form similar societies with the idea of preventing tuberculosis, one of our main objects was to acquaint the public with how tuberculosis was acquired and how it might be prevented and even cured. The result today is that it is almost impossible for you to go out and stop a man on the street and ask these questions regarding tuberculosis but what he will have some rational ideas on the subject. There is no reason why knowledge should not obtain in regard to heart disease, but it certainly does not. The public at large believes

people with heart disease are liable to die suddenly, whereas with one exception, angina pectoris, they rarely die suddenly. The public at large does not know the way in which heart disease is produced, and I think perhaps our greatest hope lies in just that one thing—general education. The heart clinics relieve the individual, help largely to disseminate information and the convalescent home acts very much in the same way, but until we can get knowledge widely diffused and generally absorbed I do not think we are going to be able to accomplish a great ideal in so far as the health of the country as a whole is concerned.

Dr. Sailer (closing): The Heart Association in Philadelphia has already accomplished much. The cardiac clinics are satisfactory; they cover the whole city well. Representing only two years' work and due, as they are, entirely to the efforts of Dr. Talley, they are something of which the whole city can well be proud. Work in occupational therapy has been very difficult to establish, but it has shown already that it is capable of very valuable results. We have now several patients who have been taught easy trades, chiefly basket-making, and are able wholly or in part to support themselves. The improvement in their mental attitude is not the least satisfactory feature of this work, but it has been difficult to obtain teachers and to form classes. Our convalescent home has failed to relize my hopes. It is well managed and the children have excellent care, but it is entirely too small. It should never be necessary to turn away cases suitable for care in that home. There should also be a separate institution for the cases that Dr. Stroud has designated as Class 3. Many of these patients are living at home under housing conditions that are intolerable and they would be far happier and live longer in an institution. We should therefore be prepared to care for them, not because they can be cured, but because their sufferings can be palliated. We also need convalescent homes for adults. This problem has not as yet been met. In New York they have been able to do more for school children with heart disease, and I feel that it is a reproach to our Association that we have done practically nothing in this line. We realize, I believe, some of our defects, and I hope that everyone will be willing, where possible and when possible, to help us to overcome them. The National Association will do one of the things most essential to the country; it will attempt to provide care for heart cases in the outlying districts. In large cities there is no difficulty, but in sparsely settled communities there are few physicians and practically no facilities.

Dr. Talley (closing): I wish I merited Dr. Sailer's statement with respect to my part in the organization of the cardiac clinics here in Phila-

delphia. His own enthusiasm and the very active work of Miss Heikes, secretary of the Philadelphia Association for the Prevention and Relief of Heart Disease, were large factors in our success. Furthermore, the widespread interest aroused by the work in New York aided tremendously in gaining a ready response from the medical men and from the social service departments of the various hospitals.

Dr. McMillan (closing): Dr. Anders' point brought up a thought to me—if you will notice, one-fifth of the whole district is devoted to that. As to the tonsillectomy. I hope I made it clear that our attitude should be that it is an attractive theory and something to start with that we have some method of controlling heart disease. We do not want to take out a normal tonsil, but it has been my experience that the most capable nose and throat men are unable to recognize diseased tonsils. I have several times seen tonsils declared free from disease by nose and throat men and they have been removed and under the microscope exhibited evidence of infection. It is a point one should have an open mind about.

Dr. Stroud (closing): I am afraid I talked longer than I should, but points Dr. Goepp brought up about in this country from the standpoint of turning patients down for occupation because of systolic murmur. I do not know whether any lawyers are present in this audience. I wish we could interest them to change the compensation law which prevents men with even suspicion of heart disease being given occupation, at least modify such law so that men suspected of having heart disease, as Dr. Sailer suggested to me, could be given occupation with the understanding that the employment of patients with certain physical signs in no way would make the employer responsible. Dr. Anders, Dr. McMillan has at least spoken of his position with regard to tonsillectomy, and we want him to understand that we all understand that it is not conclusively proven that tonsils if removed prevent recurrence of heart disease, but the reason that is included in requirements at Wynnewood Home children come out supposedly having tonsillectomy and half of the tonsil is left, and these children develop acute tonsillitis, and it spreads to other children in the home, and whether we are correct in believing these tonsils are a very big factor in continuing heart disease or not, I think we have to take the responsibility of attempting to prevent the spread of tonsillitis in the home, if possible. I feel very much personally, although I started out with the other feeling, as one of the physicians here tonight who has just left, said that he was not radical about tonsillectomy—he believed that every child's tonsils should be removed. He thought the radical man was the one who said the tonsils should always be left in—because of infec-

tions. I would not make the statement myself, but it was a very good man who made that statement. The more we see children with rheumatism and heart disease the more I feel the least we can do is to clear up a possible source of infection in these children where we are afraid we are going to have recurrent attacks of heart disease.

Dr. Abbott: I suppose it is because I know nothing about it that I feel so optimistic. I am not in a position to discuss the subject in detail, but even so, I cannot but feel that a topic of such extraordinary interest and importance as heart disease, using the word in its generic sense, cannot be clarified by haphazard methods of consideration. What we have heard tonight is a well-organized well-systematized plan of attack, and I have yet to see any well-organized, well-systematized plan of attack against any obstacles meet with total failure. So you see from that standpoint I have some reason for my optimism.

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Mental Hygiene in Industry

BY ELTON MAYO, M.A.

In the last century of human effort the sciences upon which medical practice is based have been immensely developed, so also have those economic sciences which guide industrial organization. This impersonal development of human knowledge has been of incalculable benefit to society, of so great benefit, indeed, that there has been a tendency to forget the part played by human desires in the determination of individual and social health. Mental health is not merely the product of a sound heredity and physical well-being; it is also a consequence of the successful adaptation of individual desires to social uses. Education, in this broad sense, is all-important to sanity, and education thus conceived has not had of late the attention it deserves. No student of the human sciences can rightly conceive education as being complete when school or university is left behind. Every social institution is educational—the home and the factory equally with

the school. And if industry is failing to adapt the individual human to its methods then something is wrong somewhere. That is to say, there is a problem which demands investigation.

Industry is socially necessary for two reasons. In the first place, it is by industrial effort that our material needs are fulfilled. This fact everyone recognizes; what is not so universally recognized is that industry is socially necessary in order to provide a social means of expressing mental activities. This second fact is neglected, to a surprising extent, by social practice and theory. "Work" is usually defined by the economist in terms of material needs; "labor" is one of the chief factors in the production of wealth. This abstraction of economic science is justifiable provided that we remember, in practice, that work is necessary to sanity. The individual who has no work or vocation or occupation in life cannot be sane. "Hoboes" are to be found both among the poor and the wealthy—persons whose life outside the economic and social scheme of things is due to or has induced abnormality. The necessity of vocation or work to sanity is further illustrated by the fact that no psychoneurotic is ever completely rid of his symptoms until he has returned to his work. Work is the royal road to mental freedom and normality. The conditions of work which society imposes on the individual are consequently of vital importance both to the individual and society. Conditions which are humanly unsuitable make for irrationality and "unrest," conditions which are satisfactory lead to interest and rational development. This fact I propose subsequently to illustrate.

Before proceeding to consider the concrete facts, I must refer briefly to two modern investigations—the psychopathological and the inquiry into industrial fatigue. Psychopathology is in these days a puzzling study for the layman or for the medical practitioner whose specialism lies in another direction. Many different schools of thought occupy the field; accusations of heretical or of "dangerous" thinking fly in every direction. The confusion is further increased by the multiplicity of newly-coined terms supposed to be descriptive of mental states. Yet in spite of this

confusion there is a growing conviction that the psychopathologist has an important contribution to make to social and medical knowledge. The difficulty is to define the precise nature of this contribution.

For purposes of this paper I shall venture to put all this discussion aside and to claim that the various psychopathological schools are, in fact, investigating the educational effect of revery. Pierre Janet's case Irène illustrates the effect of prolonged pessimistic reveries upon a hysterical subject. The dominant reveries of an individual determine him to mental health or unhealth and to an extent far greater than the moods of concentrated thinking with which such reveries alternate. The reveries of a Darwin are objective and scientific, and the "Origin of Species" is the result. The reveries of a psychoneurotic are not merely fantastic and irrelevant to reality, they also occupy too great a proportion of his time. And his neurotic incapacity to adapt himself happily to his surroundings follows—the effort to adapt results in "breakdown." Psychopathology, thus understood and practised, has an important part to play in industry. Machine production tends in any case to be monotonous; modern schemes of mass production make it more so. This means that over wide areas individuals drop into revery once a mechanical habit has been successfully established—and for the better part of the working day. Given any tendency to abnormal or pessimistic revery, such methods of organizing work cannot but increase it. No psychological investigator of industry can fail to be struck by the almost universal incidence of pessimistic revery under modern conditions of factory production.

The second investigation that calls for brief mention is of interest because it points in the same direction. Fatigue was at first considered almost entirely from a physiological viewpoint, and efforts were made to apply in the factory the findings of the physiological laboratory. This was attended with some degree of success —and the work continues. There has, however, been increasingly manifest in the work of those who conduct such investigations a desire to find some means of taking account of what they

term "mental fatigue." Watts, for example, in his "Introduction to the Psychological Problems of Industry," says, by way of summarizing a lengthy discussion of fatigue: "In spite of much excellent work which has been done there is as yet *no* test for the determination of the extent of industrial fatigue which takes cognizance of all its complex forms. But it would be a definite gain if we could bring the phenomena of mental weariness by unanimous consent into the category of fatigue. . . . In its chronic and most insidous forms it is largely responsible for the disturbed condition of our industrial life." In the last few days the British Industrial Fatigue Research Board has published a monograph on "The Extent and Effects of Variety in Repetitive Work." This pamphlet maintains that unrelieved monotony of work goes far to produce "temperamental" abnormality in the worker, thus causing social and industrial unrest. Monotony tends also to diminish production.

The inquiry into fatigue arrives at conclusions, therefore, which are broadly coincident with the findings of psychopathology. Somewhere in this area of investigation we shall find the beginning of a real mental hygiene of industry.

The initiation of an industrial inquiry of this type is not easy. The facilities of the neuropsychiatry clinic are entirely lacking; the investigator has no right to ask questions—he must wait until his help is required. There is no other way than that of investigating individual situations; in a given department of machine-work one man may adapt well and others fail utterly. Account has to be taken not merely of the conditions of work but also of the past history of each individual (including his dominant reveries) and of his present domestic situation. In different cases one finds that the emphasis may lie on one or other of these three or on all of them. But all three inquiries are important. The general conclusion is that mental fatigue, like psychoneurosis, is due to an attempted adaptation that has failed. And the high incidence of failure calls for criticism not merely of industrial management but equally of education and social psychology.

There is very frequently a close resemblance between the men-

tality of people engaged in industry and the mentality of those who have become "cases" in a psychoneurotic clinic. The difference is that whereas the latter have "broken down," the former are still carrying their mental burdens. It is this fact which makes the organization of occupation more important in the factory than in the clinic. The work he does will make the eccentric (but normal) individual more sane if it interests him. In proportion as it encourages the growth of pessimistic meditation his occupation drives him downward toward his brother in the clinic.

The following cases are mainly taken from one Philadelphia factory in which the employer is exceptionally humane and the morale of the workers unusually high. The cases are typical and not specially selected, except in that in every instance their work is exceedingly monotonous:

Class I. J. A., male, aged nineteen years, several younger brothers and sisters maintained by State as orphans. Social surroundings defective in that he has insufficient society of boys and girls of his own age. Reveries of fire and money. Dreams of money and setting fire to things. In infancy he used to set fire to things and get into trouble. He has no interest in the work he does. His employers regard him as an intelligent and satisfactory worker.

K. B. Personal situation and occupation very similar to above case. K. B. suffers periodic fits of depression.

Class II. L. C. Female, aged twenty-two years, resides with married brother. Reveries much concerned with her health and some unpleasant recollections. Four years at monotonous machine-work. For the last two years increasingly hysterical.

M. D. Female, aged twenty-eight years, same occupation as L. C.; for five years sole support of mother and five brothers and sisters, after father's death. Hysterical "breakdowns" in the last three years. Was engaged to be married but has broken it off, after reveries on the responsibilities of marriage and her mother's situation.

N. E. Female, aged twenty-two years, two years of same occupation as L. C. and M. D. Partly supports family; a demented father in the home; many reveries on this topic during work. Symptoms of incipient hysteria.

All three girls were at one time "good producers" in the department. M. D. was for a time the best worker. In every instance producing capacity has diminished with the emergence of fear—ridden reveries and hysteria. Every case of "cramps" that reported to the dispensary in one month came from this department.

Class III. *Three War Cases.*

O. F. aged thirty years, male, unmarried, suffered insomnia. Domestic situation unhappy, probably by reason of O. F.'s irritability. One lesson in the right method of going to sleep sufficed to clear this case.

P. G. Male, aged thirty-seven years, married, no children, twelve years of monotonous machine-work with interval of two years of military service. Reveries entirely occupied during the working day with incidents of war. Expressed fear that "neuritis" was due to "being gassed." Medical examination negative. He had not been "gassed." His symptoms imitative of an actual physical ill his wife suffered.

Q. H. Male, aged twenty-nine years, married. Reveries during work entirely of unpleasant experiences in France—death of chum and so on. Restless and discontented with monotonous work. Recommended to give up thinking about the war. He successfully followed this advice and shows marked improvement.

I cannot forbear from adding to this list two curiosities of revery encountered in elderly mechanics. The one asserts that he was born ten minutes late and has been ten minutes late for everything ever since. The other hears an English skylark sing at 3 o'cock every morning. Twenty years ago he used to get up at 3 o'clock in the morning in England to hear the skylarks sing. He has only heard the bird's song in North Philadelphia since his wife died five years ago. All the above workers, with one possible exception, rank high in the opinion of their employers and associates.

In work of a less monotonous order one encounters as many superstitions and eccentricities in the personnel employed. Where variety is possible, however, eccentricities matter less and do not flare out into expression as eccentricities of behavior or so-called "temperamental" resentment.

Individual investigation of this description is important, but by itself is not enough. The effect of working conditions requires to be more generally considered. Some time ago we were invited to inquire into the causes of a "high labor turnover" in the spinning department of a knitting mill. Every year approximately 100 men had to be taken on in order to keep about 40 working. Certain "efficiency" experts had failed to solve the problem. We discovered very speedily that the men were suffering from physical fatigue, from something in the nature of an occupational muscular dystrophy and from pessimistic reveries. The last-named reveries were endured in silence for periods which varied with individuals, but in the majority of instances flared up at last into anger and abandonment of the job. We began to experiment with ten minute rest-periods in which the men were instructed in the right method of securing a maximum of muscular relaxation. For a time we did this with a single team; the results were encouraging, but we could not directly observe the effect upon production. In November, 1923, the system was put into operation throughout the department and the effect was seen immediately in reduced labor turnover, reduced absenteeism and increased production. In March, 1924, the production fell to 70 per cent of the possible 100 per cent. Inquiry showed that in this month, for various reasons, the rest-periods had been abandoned for ten days and had been irregular in incidence during the remainder of the month. The proprietorate accordingly ordered that the machines should be shut down during four ten-minute periods every day in the month of April. The production for April was 77.50 per cent, that is, 10 per cent more than in March, in spite of the fact that the sixteen spinning mules were run for forty minutes less per day than in March. In May a system was introduced by which four ten minute rest-

periods were ensured to every worker without shutting off the machines. The production for the month rose to 80 per cent. On one day it was 89.25 per cent, on another day 92.05 per cent. The total for the month would have been higher but for the fact that the spinning-mules on several occasions outran the machines that supplied them. These figures give the productive aspect of the case; the more human situation is revealed in the fact that the loss of workers (the labor turnover) has for many months been negligible.*

One cannot claim that the investigation is sufficiently far advanced to provide a critique of industrial and social organization. The situation is rather that the mental hygiene movement is developing a technic of inquiry; it is not yet ready to enunciate principles. But the outlook is encouraging and the work promises to be fruitful of good results for the individual, the industry and the society. Incidentally it is interesting to note that the general direction of development in Philadelphia coincides very closely with that in England.

This method of applying a mental hygiene technic to industrial investigation must not be confused with the work of the psychiatrist proper. The mental situations investigated are all normal. At every stage the verdict of specialists in physical and mental medicine is immediately sought if there is any reasonable doubt as to the health of the individual. In every instance where medical attention is required the individual is sent to hospital or placed in charge of a qualified medical practitioner. This investigation is therefore to be distinguished from that which seeks to remove the psychopath from industry. It is rather designed to aid the average individual in the sometimes difficult task of adapting himself to his vocation; it is also designed to help society to discover how best to adapt vocations to the more human requirements of civilization.

* Since the above was written ten months have elapsed. In that period the spinning production has not fallen below a 79.50 per cent average for any month and has risen to 86.50 per cent in one month. The "temperamental" labor turnover has entirely ceased.

DISCUSSION

Dr. Charles W. Burr: In order for a discussion to be interesting there should be fundamental differences of opinion. Now, I am sorry that with all my love of argumentation I cannot fundamentally differ at all from Dr. Mayo. In fact, I agree with him, much more than I usually agree, so that I scarcely know how to discuss it, except, possibly, to emphasize still more one or two things that he has spoken of. First, this matter of work: You know I think it is becoming the popular notion that work is a bad thing, that we all would be happier if we could be just idle. I think that is the cry today. It certainly is the method employed in the work of the child—I mean school education. There everything is done to unconsciously make children believe that they must not work, they must not study hard, they must not compete with each other. Johnny Smith must not be No. 1 because Tommy Brown's feelings would be hurt; there must not be order in the way in which their work is done, and I can illustrate that by a story that happened in real life. I was visiting an old friend of mine and a little boy came in to show his father his examples. No 1 was up here on the sheet, No. 2 was down here and No. 3 was somewhere else, and blots were scattered galore, and the father said to the boy, "Jack, won't your teacher give you a demerit mark for such a disorderly paper?" to which, quick as lightning, it was too quick, "No, Dad, Mr. S. told us only yesterday, 'Boys, get it done, it don't matter how, but get it done.'" In other words, that little boy was being taught that accuracy in labor was of no value. Now that was a little illustration of one of the great evils of this country. First, that the child is taught that work is a thing to avoid, that it is a curse and also that it doesn't matter how he gets his job done so he gets it done. Now, as a matter of fact, the only happy people that I have ever seen have been people who not only had work, but who were working and who worked up to the time of death, unless some physical thing kept them from it, and that is true of the queer, the eccentric, the pseudogenius, quite as much as the common, ordinary, every-day person. I think the most unhappy person in the world is the business man who has made his fortune and then says, "Now I am going to retire to have a good time!" Very frequently he comes to me for some mental trouble, due to high blood-pressure, or the reverse, too low a blood-pressure. The greatest thing for mental health, barring a good physical machine, of course, is an occupation, and I think the great good of industrialism has been that with the increasing population of the earth it has given more and more opportunity for people to work. Now, that is a good sign. On the other hand, the

average working boy, at least the average working boy of my acquaintance, has very little choice when he grows up—boy or girl—what his work is going to be. For example, the son of an old locomotive engineer whom I have known for many years wanted to be a locomotive engineer, and in his eyes his father was a very great man who could run a great machine like that at sixty miles an hour and take care of it, was an important person, and he from childhood on had wanted that sort of work. Labor union conditions were such at that time in the city where that boy lived that when he grew up he could not become a locomotive engineer, and became a foreman on a railroad with a view of becoming an engineer later on; the quota had been filled, he just could not make it. He had to work and the consequence was that he took the first thing that came along. Although he was a bright boy, and his father had money enough to keep him running while he was hunting for work, he was not a boy with enough intelligence and enough imagination to say, "Now I cannot be a locomotive engineer. I will hunt up some work that is similar to that in the kind of effort I must make," he was not mentally high enough for that. He took the first job that came along that paid a good wage; it was one of those monotonous jobs. He never broke down, or indulged in the reveries of pessimism, or ever became psychoneurotic in any way, but that young man, now forty, instead of having led a happy, useful life, and one which in the end would have paid much better wage, is still going through a motion like this (illustrating), I do not know how many thousand times a day, while something happens over there in which he is not interested. Now has he been in any way affected? I do differ from Dr. Mayo in this. I think the people who are overwhelmed by monotony of work have something the matter with them. I do not mean they are insane, but do not have adaptability that some other men have. These men in middle life, instead of being happy and useful at work, as Nature intended, are neither, having gotten no satisfaction except from the most primitive of instincts. There should be some way in which to judge what type of boy should be given what kind of work. There are boys and girls Nature intended only to push a treadle; they have not mentality or imagination enough to have the slightest sort of dream, or nightmare, of pessimism or optimism; they are not much above an oyster; these people can be used with safety to the community in giving them inferior jobs. Every boy and every girl who has it in him to do work in which a machine helps the hand—my shoemaker, for example, the father of my present shoemaker, was an artist quite as much an artist as the man who painted these pictures and just as proud of his work; he knew a whole lot of things about shoes that nobody else knew, or that very few people knew, and he was proud of his work, and every pair of shoes he made

gave him joy; but no man can get joy standing at a shoe-making machine, pulling a lever and driving a peg into a shoe; he would have to be something superhuman to get pleasure out of that. So, as I say, when industry can fit men and women for their jobs a great deal of acquired mental disease, or mental abnormality, will be done away with. Now, we have made one great mistake in this thing of attempting to settle people where they belong, I mean in our worship of the printed book. It is dinned into our ears all the time that book education is the one thing in this world. If you only had enough learning, meaning by learning what we learn out of books, you would be a great man or a great woman. Now, there is not a person in this room that does not know perfectly well that there is a very large number of people whom Nature did not intend to be intellectual, and to try to make these people intellectual is very often to drive them to definite mental disease. I see almost every day young men and young women who, because they have for years been trying to do a thing that Nature did not mean them to do, I mean in intellectual development, have broken. Of course, they had in the background the protoplasm that could break, or they would not have broken at all, but had they been given hand-work, had they been a hewer of wood and a drawer of water instead of being second-rate doctors, third-rate clergymen or total failures as business men they would have been very much happier—they would have filled their niche in Nature's work and pushed everything along and been of some use in the world. Now, I think we in America are greater sinners in this respect than all the rest of the world put together. We boast that we spend more money in education than the whole civilized world outside of ourselves. A large part of it is money absolutely thrown away. We see that not only in the primary schools and in the colleges, we see it in the professional schools. I have taught for twenty-five years, and in all the years of my teaching I have seen every year two, three, four, five, ten and sometimes twenty young men come into a medical school whom Nature never intended to study medicine at all. They were temperamentally unfit, unfit by heredity, unfit by everything. Well, now we have improved in one thing. When I was a student we used to let these men drag on, year after year—one man in my class in the medical school who had been in the first year nine years. In Pennsylvania we have gone so far as to throw most of them out by Christmas in the first year, but they ought to have been thrown out of school long before that. They should never have been allowed to take the course preparatory to medicine. It was a mistake. Now that was productive of more or less definite mental disease and is a tremendous economic loss. The thing we have got to get rid of is the shibboleth that you can make silk purses out of sow's ears, or great men

from those whose intellect is that of the oyster or clam; you cannot do it, and it is worthless to attempt it. Another great error we are making today that leads also toward mental ill health because of these errors I am speaking of, I not only believe, I know, I feel quite sure I know, leads to mental ill health is so-called vocational education. It is being preached at us all the time now that we should decide when a boy is a little boy what he is going to be—I mean if he is going to be something above the mere level of a man who does what he is told, we must decide what he is going to be and then and there give him vocational teaching. We are sending him that way in medicine today. Men have been coming into the medical school (they do not know it really) supposed to be knowing so many technical things that they have had no humanistic learning at all. It is one of the evils we must be correcting. It is not only in medicine, it is in everything. Now it leads to another great evil that Professor Towne spoke of in an article published a couple of years ago. He reasons this way: Machine work, great as has been its increase, is going to increase still more and more, and the mechanic, or the man who runs the machine, is going to become more and more and more a cog in that machine. By our present system inevitably there are a large number of men and women in these positions who have intelligence enough to use their minds for pleasurable intellectual exercise. Now, if we are going to spend all their schoolboy days in preparing them for their mere vocation, what are they going to do with the hours they do not work? Twenty years from now I think you will find a six-hour day will be the average. What will they do with the rest of the time? If these young men and women were given a real education, if they were given a thing that sharpens intellect, gives them appreciation for things worth appreciating, they have something to do, but the average man today has not much to think of when he leaves his job. We do not give him the kind of education in which he can get intellectual pleasure when his day's work is done. That, I think, is the error that needs correction and the sooner they correct it the better. Now, I think the monotony of work undoubtedly has a tremendous lot to do with the reveries, the pessimistic revery, the evil thoughts, nightmare visions they pass through. I think the equation might run: Machine, monotony, consequent lack of interest, consequent fatigue. Undoubtedly where there is monotony of mental effort there is rapid mental fatigue. A man who pulls a hundred-pound weight many times a day is getting not only physical fatigue, but mental. That is the reason it does my neurasthenics good to send them off to play golf and not to stand against a wall and pull a heavy weight so many times a day. In the one there is mental fatigue, in the other there is mental pleasure.

Dr. Mayo (closing): I could give illustrations of almost every point that Dr. Burr has made, not from this particular part of the world, but elsewhere. It is very easy to see the manner in which this problem is still further complicated, the wider social issues. At the present moment there are two discussions being actively carried on in the serious-minded representatives, one is the question, What is the matter with the church and the clergy? and the other is the question, Why should we have such energetic amusements? Dr. Burr has shown why it is. I would say this, seeing the situation as it is, it is very probable, indeed, there is nothing whatever the matter with the churches or the clergy. The thing that is the matter is the method of organizing the work of the people. It is a well-known fact that people—I am referring to an instance in New York and Philadelphia—that the girls who do monotonous work are difficult to deal with in Y. W. C. A., they require a great deal of noise. So you see the amusement phase is a symptom of vocation, occupation, a method of organization, what should be the chief interest in life. If you reduce a person's chief interest in life to toil, deadly monotony, what do you do? You are imposing upon him mental disease. You suppress the higher interest he is capable of taking in life and his amusements. In other words, they are the amusements of a defeated person. You find an explanation of a good deal of the jazz movements, the kind of movie put before the public and the lack of interest in institutional religion that was quite good enough for our very healthy minded and mentally vigorous ancestors. Another point occurred to me how differently we do things in the English colonies. Dr. Burr told you a story of a student who was in for nine years doing his first year of medicine. It is still possible to do that in some universities. In the British colonies, where I come from, one individual took twenty-two years to take his B.A. degree and two years after he took it he was made director of education!

OCTOBER 31

The Preservation of the General Health of Industrial Workers

BY RALPH GOLDSMITH, M.D.

The field of industrial medicine offers to the profession the widest opportunity now existing for the fulfilment of the ideal

of effective health service on a large scale. It will be recognized that in no other social group, with the possible exception of the national military establishments, can enlightened medical service exert such a vast farreaching influence, acquire such an enormous quantity of data concerning the physical condition of the average citizen of either sex, and carry into the intimate consciousness of a great mass of our population a sense of the economic importance of *mens sana in corpore sano.* It may repay the expenditure of a few moments to inquire into how actively this opportunity is being embraced.

One need not adduce a tiresome array of statistics to prove the value of industrial medical service. Mock, in a study of the financial aspect of physical examinations for employment in ten industries, estimated that the savings resulting from this one branch of medical work alone paid the entire cost of the medical service and returned a profit of over $288,000 in a single year.

Although these figures are necessarily but approximate, still they must convince even the most skeptical that the examination of applicants for employment has a dollars and cents value to the employer that should be most engaging to that hardheaded individual. Even more obviously advantageous is that phase of industrial practice which concerns itself with the prevention and treatment of injury and disease. Hence, one would expect to find that employers, and especially employers of large numbers of workers, would welcome the installation of a health organization adequate for their needs.

The value of industrial health service to the workman seems even more apparent. He has nothing to lose by it and everything to gain. He receives at no cost to himself, under proper conditions, skilled treatment designed to place him in the job for which he is best fitted; to keep him at his greatest physical efficiency or restore him thereto in the shortest possible time; to make the conditions under which he toils the most healthful, comfortable and pleasant possible, and to indemnify him for loss of earning capacity—the result of injury or disease. In return, he is asked only to submit himself to an examination carefully

safeguarded against offense to his pride and modesty, and to coöperate by the early reporting of slight injuries and indispositions and the carrying out of therapeutic instructions.

To the medical profession the benefits of enlightened industrial practice are less concrete but none the less important. The bogey of "contract medicine" or "state medicine," that hydra-headed monster which rears its horrid visage whenever this subject is mentioned, is dispelled into thin air under the bright rays of an honest analysis. The profession as a whole and the individual practitioner as a unit should be the gainers by industrial medicine—the former through a betterment of the understanding of public health conditions and problems, the latter by the increased enlightenment of the average individual in his attitude toward his health and his physician.

Finally, it is only necessary to mention the value to the commonwealth and nation of better health and increased efficiency among the largest group of those which compose the state and nation—the wage-earners. It is quite impossible to compute their farreaching diverse effects upon the population as a whole.

If, then, not only every group affected by industrial health measures, but the nation as a whole is beneficently influenced by an enlightened supervision of the health of industrial workers, do we find a universally sympathetic attitude toward such service? By no means do we. There is opposition from each interested group—employer, worker and physician—and it does not appear to the writer that this opposition is being very rapidly overcome. It would be interesting to speculate at some length upon the causes of this unsympathetic attitude, but it will suffice to advance a single theory in explanation. One hesitates, in view of the imminence of November 4, to voice an opinion with any political implications, yet it seems to the writer that an underlying cause of the present situation lies in the intense individualism of the American people. We are a very imperfectly socially-minded race, and anything that savors of paternalism, no matter how benevolent, or of socialism, in however diluted a form, outrages our sense of independence and our *amour propre*.

As one man, a veteran superintendent in a large mill, expressed it: "All the American workingman cares for is what he gets in his pay envelope. He would rather find an additional half-dollar there than have all the welfare work in the world." Although this is an extreme statement, there is certainly a grain of truth in it, and it goes far toward explaining the indifference, if not actual hostility, that a large proportion of workers exhibit toward industrial health measures. As regards the employer, it is often difficult to convince him of the practical value of such service, and still more so to keep him convinced in the face of business depression. That, to my mind, is the fault of the doctor, for the reason that he deals all too often in beautiful generalities instead of being able to produce figures in support of his statements. In respect of the opposition of many physicians to industrial medical work, it may be said that their hostility is based upon the idea that such service takes from the practitioner cases that should properly be his. It cannot be too strongly emphasized that exactly the opposite effect should, and usually does, obtain. It is the function of the industrial physician, as it is of all the Æsculapian brotherhood, to prevent disease. Once the malady has developed, however, it should be his province only to give whatever assistance may be necessary to the family practitioner to whom he has referred the case. This is the rule in most industrial plants, and should be operative in all.

The fuller exploitation of the fertile field of industrial medicine is an opportunity and a challenge to the profession. It can best be accomplished by the entrance into the field of men properly trained for the work that lies before them—men who have outgrown the old notion of the "company doctor" as a sort of glorified first-aid man, finger-bandager, splinter-remover and iodine and "C. C. pill" dispenser. The man needed is the man with vision, who can see the broader social aspects of the work. He should have the knowledge and the persuasiveness to impress his viewpoint upon the employer. He should possess the skill, tact, dignity and sympathy to win the respect and confidence of the worker. He should—aye, must—have the honesty, fairness

and frankness to disarm the suspicions of the local practitioners and to gain their coöperation. Such men could so elevate the status of industrial hygiene that it would greatly increase in value to the employer, the workman and the public, and would be a fascinating and profitable calling.

Health measures in industry are as many and various as the industries themselves. Each has its own individual problems, and each demands a different plan for their solution. Since it is impossible to consider them all in detail, it seems best to discuss the procedures which are more or less applicable to call. Therefore, we may dismiss the peculiar preventive measures designed to safeguard the worker against dust and gas inhalation, explosion, falls from heights, dangerous machinery, burns and many other hazards, and concern ourselves with less specialized but almost equally important general hygienic matters.

Let us begin with the applicant for employment. The writer is a steadfast believer in the physical examination of prospective employees as a reducer of labor turnover, a prophylactic against contagion and a most valuable means of preserving or improving the health of the individual worker. It is known that the average cost of training a new employee is in the neighborhood of fifty dollars. If, therefore, even 5 per cent are found unfit and rejected, or placed in positions which they are able to fill, the saving in turnover in an industry employing one thousand persons a year amounts to twenty-five hundred dollars. This is the least important phase of the matter, however. The prevention of the introduction into the plant of contagion and, more particularly, the discovery and correction of remediable maladies is an economic and social gain, the importance of which can scarcely be overestimated. Then, too, the question of physical fitness for the job is one so intimately concerned with the health and contentment of the worker and the maintenance of his output that neither the employer nor the employed can afford to disregard it. The standard physical examination made by the writer at the factory of S. B. & B. W. Fleisher, Inc., is as follows: Weight; height (in those who have not attained full growth); inspection of

teeth, oral mucous membrane and tonsils; test of vision by the Snellen type-card, and in the case of those whose work requires constant use of the eyes (stenographers, inspectors, etc.) by the near-point card; skin, especially in food-handlers; lungs; heart; blood-pressure; feet; hernia and venereal diseases in males; urinalysis. The result of the examination is charted on a card, together with the name and address of the worker's family physician, whose coöperation is sought for the correction of any abnormalities discovered. It is usually possible during the course of the examination to obtain a brief history of previous or existing illness, which may lead to further special examinations. Serious disability or the presence of infectious diseases results in the barring of the applicant. It is our policy, however, to make every effort to find some work for the applicant and to help him to overcome his disability.

By far the commonest defect discovered is oral sepsis. Fully 85 per cent of persons examined have either gingivitis, pyorrhea, cavities or decayed stumps of teeth, and this is true even in the very young. Dental service is sadly needed and training in the care of teeth even more so. One so frequently encounters remote effects of this focal infection that it is commonplace. It is no easy matter to coax many of these people into going to the dentist, and most of them can ill afford to pay the necessarily high cost of good modern dentistry. Therefore, it is highly desirable to employ a dentist to clean teeth, do simple fillings and extractions and to recommend other necessary work, and, indeed, this is the only way of getting it done.

Refractive errors are very common. If merely advised to get glasses, the employee has a tendency to disregard the advice or to go to an irregular practitioner whose prescription is not always precisely adapted to the visual defect. We have, therefore, made an arrangement with a very skilful ophthalmologist and a reputable firm of opticians whereby our employees are properly fitted at a very moderate cost. If they cannot meet the cost money is loaned them to defray this expense from a special fund.

It would not be profitable to detail how each abnormality is

handled. Suffice it to say that each case is individualized and every effort made to help the employee to conserve his health.

The value of physical examination is directly proportionate to the care with which it is performed and the thoroughness with which it is followed up. Unless the examiner's recommendations are persistently pursued it is a waste of time and money. Success depends upon a coöperation between physician, nurse, foreman, welfare worker and employee—not always easy of attainment but possible in most cases.

Employees are urged to apply for treatment of trivial injuries and of slight illness or indisposition. No matter how unimportant the cause which brings them to the plant hospital, they are never made to feel that they should have disregarded it. It is better to treat a hundred insignificant scratches or gas-pains than to have one avoidable major wound infection or ruptured appendix. A constant propaganda is necessary to drive home the importance of prophylactic treatment, but it is worth all it costs. In the last five years we have had no serious permanent disability, no amputation, no death from preventable causes associated with the worker's job.

The functions of the industrial nurse are many, and not every nurse is able to do industrial work properly, but it is not too much to say that in a factory employing mostly women and girls the nurse is second to none in influence upon the worker's health. It is she to whom the employees bring their troubles, as often those of the mind and heart as of the body, and it is her tact, gentleness and understanding which endear her to them and make them receptive of counsel which they might otherwise resent. It is she who acts as mediator between the shy, timorous girl and that frightful ogre, the doctor, and persuades the former to seek assistance which she would otherwise be too timid to request. It is she who can best handle the peculiarly feminine ailments, and by a few simple measures convert the woman with habitual dysmenorrhea from a constant time-breaker to a regular worker. It is she who discovers that the girl who constantly complains of headache and weakness is suffering from

an ailment no more serious than an omitted breakfast and an insufficient lunch. Her more formal functions within the plant itself are assisting the doctor with examinations, dressings and other treatments, the care of minor injuries and illnesses in his absence, the giving of massage, baking and other physiotherapeutic measures, and in some instances the supervision of hygienic conditions in the women's lavatories and rest-rooms.

Equally important in the maintenance of the worker's health is the visiting nurse. Especially among the poorer and more ignorant classes is she invaluable. She should be possessed of a strong constitution, an abundance of vitality, no invincible distaste for hard and sometimes dirty work, and should have in addition training in public health nursing. Her function is to call upon workers absent from their tasks by reason of illness or for unknown causes. The conditions which she sometimes encounters are appalling, and the value of her services incalculable. One or two cases in point will illustrate what a power for good she may be:

M. MacC. was absent from her machine for three days for unknown reasons. When visited it was found that this girl, eighteen years old, frail and undernourished, had been for some weeks the only support of her widowed mother and several younger children. There was no money in the house, no fuel (and this was in the month of February) and the only food was that given by neighbors who could ill afford to spare it. The girl was lying on a bare mattress under dirty ragged covers among surroundings of indescribable filth and was in a state of high delirium with what was evidently a well-developed case of lobar pneumonia. The nurse immediately summoned the plant physician, ordered fuel from a nearby dealer, built a fire, heated water, bathed the patient, obtained food for the family and within six hours the patient was in the hospital, the house was warm and clean and the family fed.

M. G., a woman, aged forty-two years, had been losing time on the plea of illness. She had enlisted the sympathies of her fore-

man as well as the medical department and for some time had been helped financially as well as in other ways. This had continued for a considerable period when a visiting nurse was engaged. Her first call at the woman's home revealed the lady in question in a state of alcoholic exhilaration which incapacitated her for work for several days. It was then found that this had been the cause of her frequent indispositions and she was promptly removed from the payroll.

Thus it will be seen that the visiting nurse serves the multiple function of aiding the sick, improving home hygiene and preventing imposition upon the good offices of the employer.

It is impossible for an undernourished individual to remain in good health and to be an efficient worker, therefore the question of the nutrition of the workmen is of great importance. Especially is this true in industries employing many adolescents and young adults. While it is manifestly impossible to govern the quantity and quality of the food the worker gets at home, a great deal can be done by making available a hot, nutritious, attractive, ample lunch. This is accomplished by the company-run cafeteria, where the employees can obtain good food at very low cost. It may be stated that this phase of industrial health work can scarcely ever be conducted except at considerable financial loss. Furthermore, it is one of the most difficult undertakings to operate in such a way as to give universal satisfaction. Tastes in food are as varied as anything well can be, and for this reason alone there never fails to be more or less grumbling at the food which is being supplied at perhaps one-half what it costs. If this fact be understood at the outset much vexation will be avoided. But the problem of nutrition is not solved by this measure alone. It is frequently necessary to provide emergency meals for the employees whose food is so bad at home that even the one good meal which they get at the cafeteria is insufficient. Furthermore, much good may occasionally be accomplished by permitting workers who live close to their place of employment to take out trays of food to their homes for other members of the family who may need it.

The value of rest and recreation in the maintenance of health and efficiency is too well-known to require elaboration. In these days of high-pressure living it is essential that attractive, comfortable rest-rooms should be provided for the use of the workers. These may be under the care of the nursing staff and should always be easily available. Facilities for dancing during the lunch hour are greatly appreciated and extensively utilized. The fact that the love of music is a fundamental trait of mankind is attested by the fact that at Fleisher's the player-piano is never silent during the rest period. Male workers are generally more interested in athletic sports—volley ball, basket-ball, etc., are played indoors, while on the athletic field baseball and soccer are the favorite sports. The annual theatrical performance is always a huge success from the standpoint of promoting *esprit de corps* as well as providing a topic of fascinating interest for weeks before and after it is given. The importance of rest periods is just beginning to be understood. A very recent experiment by Dr. Mayo, of the Faculty of the University of Pennsylvania, has demonstrated a marked increase in efficiency as a result of short regular rest periods.

Plant ventilation and plant sanitation are of course essential to the worker's health. These, however, are so manifestly problems which must be individualized in each establishment that it would be profitless to discuss them here.

Despite all efforts to preserve the health of industrial workers it is inevitable that there will be a certain morbidity and mortality among the personnel. Many concerns now provide health and life insurance for their employees, either entirely free or with the aid of small periodic payments by the workers themselves. This insurance is of course a great boon to the workers or their families in case of sickness or death, and in many cases does much to further a feeling of loyalty to the employer. It is not, however, without certain dangers—notably the tendency of a proportion of the beneficiaries to attempt to obtain the benefits by malingering. This state of affairs makes necessary a careful scrutiny and investigation of every claim and inevitably works an occasional

injustice. This must be very carefully guarded against, for it need not occur very often to result in discrediting the entire insurance plan.

The subject of health service in industry is such an enormous one that it has been impossible in this discussion to do more than touch briefly upon its more salient general features. But involved, difficult and sometimes discouraging as this work is, it is equally interesting and very well worth while, and it is the hope of the writer that it will be found so by an increasing number of able men.

DECEMBER 19

The Physical Condition of the Population of Philadelphia as Revealed by the Draft*

BY MAJOR ALBERT G. LOVE, M.D., M.C., U. S. A.
(By invitation).

I wish to express my appreciation of this opportunity to present to you some of the public health aspects of the information derived from the physical examination of the Selective Service men in 1917 and 1918. As you are aware, the interest of our chief, General Ireland, in the public health of the country is not even secondary to his concern for the health of the Army.

It was during the World War that we had our first opportunity to obtain information regarding the physical condition of the young men of the country as a whole. In accordance with the Selective Service Act, 10,838,315 men between the ages of twenty-one and thirty years registered under the first and second registrations. We will consider only this group, of which 3,764,101 were placed in Class I, or as economically and industrially available for military service. Of the Class I men, 549,099 were found by the local boards to be physically or mentally unfit for

* Authorized for publication by the Surgeon General.

any form of military service; 2,750,000 were inducted and the remainder either volunteered or were awaiting call at the time of the Armistice.

Probably many of you assisted in the physical examinations, either as members of one of the local or camp examining boards. You know that each man was examined by his local board; in certain instances referred to an advisory board; and if sent to camp, upon arrival there, was again examined by a carefully selected group of medical men. These camp boards consisted of from four to twelve doctors, the various specialties being represented. While the examinations were necessarily hastily conducted, you will probably agree with me that they were more carefully done than any similar group previously made in this country. Needless to say, many important defects escaped detection; consequently the findings must be considered as a minimum.

It was early recognized by the offices of the Provost Marshal General and the Surgeon-General that this unusual opportunity to make a general survey of our population should not be allowed to pass without being utilized, for the importance of the knowledge to be obtained was many-sided. From the standpoint of social and industrial life it gives some insight into the availability of the American people for the various occupations which our social organization requires. It indicates the physical and mental status of our population in various sections of the country under the different sanitary conditions which prevail and with the varying opportunities for medical and surgical treatment. It indicates the proportion of our men available for strenuous work and also the nature and size of the task before those who would seek to improve by better conditions, as well as by better care and surgical treatment, the physical and mental status of our population. Finally, it has a biological and eugenic significance in so far as it reveals the inherent failure of man to make complete adaptation to the rapidly advancing requirements of a highly artificial civilization, and in so far as it throws light upon the constitutional limitations of the various races composing our population to meet the conditions imposed by that civilization.

Since the physical condition depends so largely upon economic, social, racial, environmental and industrial factors, it is essential that if we are to obtain a true picture of the physical condition of the population of any section or group of sections, those examined must be truly representative of all classes. These conditions were fulfilled by the draft, since the men were not drawn from any particular economic class or from any one section or group of sections of the country, for the Provost Marshal General was no respecter of persons or sections and his long arm reached out and drew them in from hither and yon—from the densely populated urban districts and from the sparsely settled mountain sections, from congested factories and from isolated farms, from clerical positions and from occupations as laborers, from the most sumptuous homes of the rich and the most squalid hovels of the poor—in fact, from every economic and social class. They were called without any distinction as to race or as to color, except in so far as military necessity dictated, and the number drafted from each section was probably sufficiently large to form a representative cross-section and to furnish significant findings.

Unfortunately, those who were responsible for the preparation of the form for the report of the physical examination failed to realize the very great importance of including space for entering the color, age, race, occupation and place where the registrant was reared. In the absence of such entries, that we might obtain these data at least relatively, we grouped the population by counties into one hundred and fifty-six sections, according to the racial, industrial or physiographical characteristics as shown by the 1910 census.

They were then assembled into twenty-two groups, state lines being disregarded. Those were: Finns, 10 per cent of total population; Scandinavian, 10 per cent; agricultural Russian, 10 per cent; French Canadians, 10 per cent; German and Scandinavian, 10 per cent; German and Austrian, 15 per cent; German and Austrian, 20 per cent; agricultural negro, 45 per cent; agricultural native whites, North, 73 per cent; agricultural foreign and native whites, North and West; agricultural native whites,

South; native whites of Scotch origin; mountain whites, South; mountain whites, United States; Mexicans; Indians; eastern manufacturing; commuters; mining; sparsely settled; desert; maritime.

The findings in regard to these groups were quite striking. Probably they are even more instructive than if we had been able to form pure racial groups, for they show to what an extent the general physical characteristics and the physique of the population are affected by even a relatively small percentage of the foreign infusion.

It would be impracticable to consider here the different defects in detail. It is of interest, however, to note in summary the marked effect that race has upon the physical condition of our people.

On the whole, the *French Canadians*, by virtue of the percentage of tuberculosis, pleurisy, nervous and mental defects, defects of the eyesight, otitis media, defective hearing, valvular diseases of the heart, bad teeth, hernia, malnutrition as evidenced by underweight, deficient chest measurement, etc., constituted the poorest group from the public health and military point of view.

The *Scandinavian* group was characterized by much flatfoot, a marked tendency to hernia and especially by the large amount of goiter—exophthalmic goiter being one and half times more common among them than the average, and simple goiter nearly three times. This group also showed more defects of the cardiovascular system than the average but relatively little venereal disease, and the condition of the eyes, ear, nose and throat among them was good.

The *Finns*, of whom there were only two small groups in the United States, were especially interesting, due to the fact that they had double the average amount of exophthalmic goiter and between four and five times that of simple goiter. But goiter, both for this group and the above, probably depended more upon the place of the former or present residence of these registrants than upon race. Valvular diseases of the heart was especially

common among them, but otherwise the group was characterized by a general good physique.

The *German* group was characterized by neurasthenia, psychoneurosis and various psychoses, but by relatively little mental deficiency; also by an excess of myopia and of curvature of the spine.

Among the *agricultural Russians* malunion of fractures was especially common. There was also an excessive amount of loss of appendages, ankylosis of joints and foot defects of various kinds. Congenital defects, including cryptorchidism, cleft palate and harelip, were also noted more frequently than the average.

The *Indians* and *Mexicans* were characterized by a large amount of tuberculosis, venereal diseases, ankylosis, cleft palate and harelip.

The *native mountain whites*, occupying the southern Alleghany Mountains, showed an excessively high proportion of mental deficiency, varicose veins, much underweight and numerous deformities of the extremities—the result of the absence of or of bad surgery.

Finally, the *negroes* were characterized by an abnormal amount of venereal disease and sequelæ, by valvular diseases of the heart, arthritis, ankylosis, hernia, tachycardia, hysteria and many deformities—the results of injuries and bad surgery—but by relatively little otitis media, hypertrophy of tonsils, defective vision, diabetes, spinal curvature, flatfoot and cryptorchidism.

Occupation also plays an important part: Millwork in the South and lumber work in the North, together with employment on the railroad, causes the loss of extremities; agriculture is associated with good eyes and straight limbs, and in the South (but less in the North) with freedom from flatfoot and distorted toes; standing in shops and walking on pavements in improperly fitted and improperly shaped shoes, together with the more constant use of them in early life, accounts for many of the cases of imperfect feet in the city population; much school and clerical work tends to produce myopia in those so disposed. In early life bad posture at school, especially among undernourished and

rickety children, accounts for much of the curvature of the spine, and this is especially true in cities with their large percentage of foreign population.

Environment, together with the grouping of races in industrial districts, is also a factor of great importance in determining the physical condition of a population. The only method by which we could make such a study was to group as urban the local boards which included only urban population; that is, where the population was 25,000 or more. The other districts, including smaller cities, villages and country, were classed as rural.

In a brief comparison of such districts it may be said that the rural districts were characterized by an excess of defects—the results of chronic infection and of those due to the absence of or of improper and indifferent medical and surgical treatment, such as trachoma, pyorrhea, traumatic defects of the extremities, blindness in one eye, hemorrhoids, hernia and deafness; of congenital conditions—the result of too frequent intermarriage and consanguinous matings in the remote rural districts, such as mental deficiency, epilepsy, defective speech and hearing, chorea and hysteria; also by an excess of certain diseases, especially gonorrhea, the result of the inclusion of a large percentage of the negro population with many rural districts of the Southern State

The urban districts, on the other hand, were marked by an excess of certain conditions—the result of chronic infections of the ear, nose and throat due in part to environment, namely, otitis media, sinusitis, defective hearing and hypertrophied tonsils; by other conditions—the result of the inclusion of a large percentage of foreign population from southern Europe and of French Canadians, such as underweight, underheight, obesity, defective and deficient teeth, errors of refraction and strabismus; by certain nervous and mental disorders, namely, neurasthenia, neurocirculatory asthenia, constitutional psychopathic state, dementia precox and psychasthenia and psychoneurosis; by foot conditions—the result of improperly designed and fitted footwear, that is, pes planus, hallux valgus, hammertoe and metatarsalgia; by other conditions—the result of varying and undetermined

factors, such as syphilis, paresis, tabes dorsalis, valvular heart disease, cardiac hypertrophy and dilatation, functional cardiac disorders, drug addiction, alcoholism and exophthalmic goiter.

Of the Class I men, 46.8 per cent had an important military defect and 21.2 per cent were rejected, either by the local or camp boards, as physically or mentally unfit for all forms of military service. In addition to this latter number, 8 per cent were classified by the local boards as available only for limited service, that is, for clerical or other duty with the non-combatant branches of the Army, usually in the United States. Twenty-nine per cent were then unfit for active military duty with the fighting units overseas. Only one-half of the limited service men were called.

The percentage of defective men according to our population groups varied from: French Canadian, 55 per cent; agricultural Russian, 48 per cent; negro, 46 per cent; mountain whites of the South, 46 per cent; Indians, 45 per cent; German and Austrian, 45 per cent; Scandinavian, 45 per cent; agricultural population of the North, foreign and native white, 44 per cent; agricultural population of the North, native white, 44 per cent; Finn, 43 per cent; agricultural population of the South, 43 per cent; Mexican, 42 per cent; German and Scandinavian, 42 per cent; native white of Scotch origin, 40 per cent.

With this variation among the population groups, the relative number from the different states varied from 64 per cent in Rhode Island to 35 per cent in Kansas. Fifty per cent of the men from Pennsylvania were found defective.

The number of Selective Service men who were found to be physically unfit for all forms of military service also varied from 42 per cent in Rhode Island to 13 per cent in Wyoming; 21 per cent from Pennsylvania were found unfit. It is evident that there is nothing in the climate of Rhode Island which would produce such an excess of defective men. The apparent explanation is that, being a highly industrialized state, it drew to its borders a class of immigrants, many of whom were defective.

Since a man frequently had more than one defect, the number of the latter naturally exceeded the former. Thus there were 55.7

defects per 100 men as compared with 46.8 defective men; or, in other words, the defects exceeded the men by 8.9. Of the men from Rhode Island there were 80 defects per 100 men; from Kansas, 42; from Pennsylvania, 60.

The physique of the population from the several states varied to even as great an extent as did the physical condition. Thus the average height or stature varied from 68.4 inches in Texas to 66.4 inches in Rhode Island; weight from 147 pounds in South Dakota to 136.4 pounds in Rhode Island; chest at expiration, 33.8 inches in North Dakota to 32.8 inches in the District of Columbia.

The average height for the United States was 67.49 inches; weight, 141.54 pounds; chest at expiration, 33.22 inches. The average height of the men from Philadelphia was 66.62 inches, or 0.87 less than that for the United States; weight, 137.6 pounds, or 3.92 pounds less than that for the United States; chest at expiration, 32.91 inches, or .31 inch less than the United States' average.

Since race is such an important factor, let us in studying your local physical condition first consider your population. In 1920 it consisted of 92.6 per cent white and 7.36 per cent negro. Of the total, 45.75 per cent were native born of native parents, and 54.25 per cent foreign born or born of foreign parents in this country. In New York City only 23.59 per cent were native born; in Chicago, 27.96 per cent; in Boston, 26.26 per cent. You had in your population 18.92 per cent English or Celtic; 9.62 per cent Germanic; 0.53 per cent Scandinavian; 7.5 per cent Italian; 1.01 per cent other Latin and Greek races; 4.79 per cent Slavic and Lettic (excluding Russians, who were classed as Hebrews); 12.66 per cent Russian, Yiddish or Hebrew; 1.65 per cent others.

The relative amount of your English and Celtic population was greater than that of New York or Chicago, but less than one-half of that of Boston; your Germanic was much larger than that of Boston, but much less than that of New York and only one-half of that of Chicago; your Scandinavian was much below that of either New York or Boston and only one-fourteenth of that of Chicago; your Italian was twice that of Chicago, but less than that of Boston and only one-half of that of New York; your

Slavic and Lettic was twice that of Boston, about the same as that of New York, but only one-fourth of that of Chicago; the Hebrew and Russian (largely Hebrew) elements were twice that of Chicago, larger than that of Boston, but only a little more than one-half that of New York.

The total number of your citizens who registered at the first and second registrations was 191.697. Of this number, 37.6 per cent were placed in Class I. The average for the United States was 34.7 per cent. Of your Class I men, 14.05 per cent were rejected by your fifty-one local boards and an additional 8.2 per cent at camp. The average for the United States was 14.6 per cent rejected by the local boards and 6.6 per cent by the camps. The total rejection rate for your city (22.25 per cent) was higher than that for the United States (21.2 per cent), the rural districts (20.3 per cent), or Chicago (22.2 per cent); but lower than the urban rate (22.9 per cent) or than that for Boston (23.7 per cent) or New York (24.2 per cent).

The number of defective men from your city (49.9 per cent) was above the rural average (44.4 per cent) and that for the United States (46.8 per cent), but below the urban average (51.2 per cent) and below that of Boston (58.9 per cent), Chicago (52.4 per cent) or New York (51.5 per cent).

The number of defects for each 100 of your men (59.8) was above the rural average (52.8) and that for the United States (55.7), but below the urban average (60.9), and also below that for Boston (69.2), Chicago (62.1) or New York (60.8).

There were more cases of *tuberculosis* detected among the men from the city (33.32)* than from the country (28.86). Philadelphia's rate (31.71) was above the average for the United States, but below that for the cities; it was higher than the rate for New York (30.91), but below that for Chicago (32.03) or Boston (31.96).

Of the *venereal diseases,* gonorrhea was more common among the men from the rural districts. This was due, at least in part, to the unavoidable inclusion of the negroes with the rural dis-

* This and the following rates are per 1000 unless otherwise specified.

tricts in the South. Syphilis, paresis and tabes dorsalis were more frequent in the cities. For the class the rate for Philadelphia was below either the urban or rural, higher than that for New York or Boston, but lower than that for Chicago.

For the disease classed as *general diseases* the rate for the city men (21.97) was greater than that for the country men (19.14), the incidence in Philadelphia (14.37) being lower than for either of them. The relative incidence in your city was also lower than in Boston (14.87) and New York (18.02), and much lower than in Chicago (35.5). The high rate for the latter city was due to the relatively large number of cases of simple (8.59) and exophthalmic goiter (11.51). Boston had the lowest rate for these two diseases, while those for Philadelphia and New York were about equal.

For curvature of the spine and the results of rickets the urban incidence (5.96) was above the rural (5.36). Your population suffered less (5.13) than either of these two groups. The occurrence in New York (5.99) and Boston (5.98) was slightly above the urban average, while in Chicago (7.64) it was one-third higher.

There were relatively more cases of arthritis among the country men (2.48) than among the men from the cities (1.99), probably due to the excess of gonorrhea in the country. Chicago was above the urban average (2.15), while Boston (1.62), your own city (1.51) and New York (1.26) were below.

Alcoholism (0.56) and *drug addiction* (1.04) were both much more prevalent among the urban registrants than among the rural (0.17 and 0.26). For the former condition Boston (1.57), with a large percentage of English and Celts, had a rate three times as high as the urban average, while Chicago (1.36), with its Germans and Scandinavians, also had one almost three times as high; but Philadelphia (0.46) and New York (0.44) were below the urban. On the other hand, the rate for drug addiction for New York (2.15) was twice the urban, and even that from your city (1.07) was slightly above it. Boston (0.86) was below the city average, while Chicago (0.24) was below even the rural.

There was a slightly higher rate for *nervous diseases* among the rural registrants (16.5) than among the urban (16.28), due to the excess among the former (5.36) (urban, 4.79) of epilepsy, which was the largest group of this class. Epilepsy was especially prevalent among the recruits from agricultural native white areas both North and South, the mountain whites of the South and the French Canadians. Of the four cities, Boston (6.13), New York (5.62) and Philadelphia (5.52) were above the rural average and below that of the group mentioned, while Chicago (4.53) was below the urban.

Functional nervous disorders, that is, neurasthenia, neurosis and hysteria, were more common in the city (0.94) than in the other districts (0.87). Boston (1.52), Chicago (1.19) and New York (1.11) had rates above the urban average, while that for Philadelphia (0.94) was equal to it.

Mental alienation was much more frequent among the country people (21.15) than the city (12.64). This was caused by the greater incidence of mental deficiency among the men from the rural districts (17.59), where it was twice as high as among those from the urban (8.77). The rates for the negro group (20.07) the maritime (21.81)—which included a large number of negroes in the Carolinas and Virginia—and the mountain whites (27.19) were especially high. Of the four cities, all of which were below the urban average, Boston, probably on account of its percentage of French Canadians, had the greatest relative number (8.76), followed by New York (8.34), your city (8.24) and Chicago (8.05).

The next largest group of this class was dementia precox, for which the city rate (0.91) was higher than the country (0.69). Chicago (1.31), New York (1.19) and Philadelphia (1.07) were above the urban average, while Boston (3.6) was four times as high.

Psychoneurosis and psychasthenia was also more prevalent among the men from the cities (0.71). Of the four cities, Chicago (1.06) was the highest, followed by New York (0.89), Boston (0.86) and Philadelphia (0.73), all being above the city average.

For the constitutional psychopathic states the incidence in the city (0.63) was again greater than in the country (0.51). New York's rate (1.18) was twice as high as the urban average, while Philadelphia (0.55), Boston (0.51) and Chicago (0.38) were below it.

We do not know how many men from Philadelphia were discharged subsequent to enrollment as unfit on account of mental or nervous conditions; but we have such information for Pennsylvania and may apply it at least relatively to the Philadelphia men.

The number of rejections of men from Pennsylvania during the draft examinations for nervous conditions was relatively 5.7 times as great as the number who were discharged as physically unfit subsequent to enrollment. Considering the separate conditions, there were four times as many rejections as discharges for epilepsy, one and a third as many rejections for neurasthenia, four times as many rejections for neurosis, but four times as many discharges as rejections for neurocirculatory asthenia and three times as many discharges for hysteria.

For mental alienation there were 3.3 times as many rejections as discharges. This was due in large part to the relatively large number of men who were found unfit by the draft boards on account of mental deficiency, the rejections being to the discharges as 7.9 is to 1. There was the same number of rejections as discharges for psychasthenia and psychoneurosis, but one and a third more discharges than rejections for constitutional psychopathic state and dementia precox.

That the psychiatrists did excellent work in the Army in eliminating in this country, before transfer overseas, those who were unfit on account of mental and nervous conditions is shown by the fact that relatively nine times as many men were discharged during the period of preliminary training in the United States as had to be returned from the A. E. F.

Due to the large percentage of foreign population, together with the great eyestrain incident to the more sedentary occupations in cities, the urban rate (58.74) for *diseases of the eye*, con-

sisting largely of refractive errors, was one-third higher than the rural (42.13). For errors of refraction alone the relative number among city men (43.97) was one and three-fifths as high as among country men (26.83). These conditions were especially common in Boston (73.75), followed by New York (68.77), Chicago (47.97) and Philadelphia (42.01), the latter being slightly below the urban average. The excess of the rates in New York and Boston over that for Philadelphia shows that foreign population is quite an important factor.

Diseases of the ear were more frequent among the recruits from cities (19.09) than the country (11.72), since chronic suppurative otitis media, the largest group in this class, was practically twice as common in urban (12.93) as in rural (6.16) sections. The latter was especially prevalent among men from New York (23.57) and Philadelphia (18.72), but the rates for Chicago (12.44) and Boston (10.79) were below the urban average.

Defective hearing was also more frequent among men from cities (5.97) than from the country (5.3). Boston (6.53) and Chicago (6.32) were above the urban average, while New York (5.91) and Philadelphia (3.82) were below it.

Diseases of the nasal fossæ were more common in urban (1.62) than in the rural (1.54) districts. The rate in Philadelphia (3.04), due to the excess of adenoids, sinusitis and chronic rhinitis, was almost twice the urban rate, while those for Boston (1.52), New York (1.49) and Chicago (0.88) were below it.

Diseases of the throat was another class which was relatively more common among the urban registrants (24.26) than among those from the country (23.8), due to greater frequency in the cities (23.48) of hypertrophied tonsils, which was the largest group of this class (rural, 22.88). Boston (29.79), Philadelphia (28.83) and New York (25.39) were above the urban average, but Chicago (17.11) was below it.

Diseases of the circulatory system were more frequent among the men from the urban (64.45) than from the rural (54.25) districts, since valvular heart disease, which was the largest group of this class, was almost one and a half times as common among

the men from cities (40.79) as from the country (28.87). The incidence in New York (48.57) was considerably above the urban average, as it was also in Philadelphia (43.46), while in Chicago (39.39) and Boston (38.65) it was lower.

Myocarditis was also more common (1.16) among those from the city than from the country (0.85). Boston (1.88) was above the urban average, while Philadelphia (1.13) was slightly below, and New York (0.97) and Chicago (0.92) were still more so.

There were more cases of cardiac hypertrophy and dilatation among the city men (5.62) than among the country men (4.11). New York (8.68), Philadelphia (6.9) and Boston (7.1) were above the city rate, while Chicago (4.27) was lower.

For the diseases of the digestive system the urban rate (59.33) was higher than the rural (53.7), since the men from the rural districts had much better teeth (12.52) than those from the urban (15.41). Those from Boston (32.17), like those from the New England States in general, had especially bad teeth. New York (14.36) and Chicago (12.91) were below the urban average, while Philadelphia (12.2) was below even the rural.

For developed *hernia* the incidence in the city (20.6) was slightly less than in the country (20.97). The four cities were all below the urban average, standing in order of Chicago (19.73), Philadelphia (19.33), New York (17.64) and Boston (17.07). For potential hernia or relaxed inguinal rings with poor musculature, the urban rate (21.14) was higher than the rural (17.8). That for Boston (32.72) was quite high, for New York (22.02) it was also above the urban average, while those for Philadelphia (18.7) and Chicago (14.33) were below it.

The diseases of the bones and organs of locomotion formed the most numerous class of defects, constituting 39 per cent of all defects and affecting 17.9 per cent of the men. The urban rate (197.8) was much in excess of the rural (168.38), largely caused by foot conditions acquired by city dwellers as the result of the early and constant use of footwear often improperly shaped and fitted.

Flatfoot was one-third more common in the cities (128.03)

than in the country (99.05). Chicago (167.04) and Boston (159.92) were above the urban average, but New York (123.32) and Philadelphia (112.46) were below it. This condition is more frequent among large-bodied individuals, and a greater percentage of the foreign population in Chicago and Boston are of the larger races.

Hammertoe and hallux valgus, acquired largely as a result of improper footwear, were more prevalent in cities (8.24) than in the rural communities (6.09). You apparently have been accustomed to the use of very fashionable footwear in Philadelphia, for your rate (10.95) was one-fourth higher than that for the general urban population. Boston must also be very fashionable, for their rate (10.33) was likewise excessive. Those for New York (7.8) and Chicago (6.29) were each below the city average.

Malunion of fracture was more common among the men from the country (7.98) than from the cities (7.35). Boston (9.76) was above the average; while Philadelphia (7.15), Chicago (7.13) and New York (6.25) were below it.

For the *congenital malformations and ill-defined diseases* the urban sections (53.57) again had a higher rate than the rural (44.79). Numerically the most important of these conditions was underweight, that is, under the required military weight for the height. The urban rate (31.33) for the latter was above the rural (23.83). Philadelphia (37.1) was much above the city average, but New York (30.52), Boston (30.09) and Chicago (27.41) were all below it.

The relation of weight, height and chest is most important, not only from a military but from a public health point of view, since it is one of the most reliable indices of the physical condition. Of the men who were sent to military camps and who were rejected there on account of pulmonary tuberculosis, 82.6 per cent were under the required weight for their stature. They were above the average in height, but slender and small-chested. All forms of organic disease of the heart were also characterized by a tall, slender, small-chested physique.

There were more men who were underheight in the cities (4.25)

than in the country (2.16). The proportion of the men from Philadelphia (8.12) was almost twice the urban average. Boston (7.04) and New York (5.91) were also higher, but Chicago (3.0) was lower. The excess in Philadelphia is strange in view of the relatively greater number of the short races in New York; but your average height (66.62) was greater than that for New York (66.46), although less than that for Boston (66.94) and Chicago (67.09). Your average weight (137.62 pounds) was less than that for either New York (138.5), Boston (139.59) or Chicago (140.86).

In comparison of the physical condition of the population of Philadelphia with that of the United States, the rates for your city were above the average for the United States for tuberculosis, alcoholism and drug addiction; for practically all of the nervous and mental conditions other than mental deficiency, namely, epilepsy, neurasthenia, hysteria, dementia precox and psychoneurosis and psychasthenia; for disorders of vision, such as refractive errors and strabismus; for chronic infections of the upper air-passages and the ear, that is, otitis media, sinusitis, hypertrophied tonsils, bronchitis and emphysema; for organic and functional heart disease, such as valvular heart disease, cardiac hypertrophy and dilatation, myocarditis and functional cardiac disorder; for acquired conditions of the feet and extremities, namely, flatfoot, hammertoe, hallux valgus and loss of extremities; for diseases of malnutrition and poor physique, such as underweight and underheight.

It stood below the average for the United States for venereal diseases, curvature of the spine and rickets, arthritis, goiter, obesity, neurocirculatory asthenia, mental deficiency, defective and deficient teeth, diseases and disorders of the veins, hernia, relaxed inguinal rings, malunion of fractures and asthma.

Likewise, in consideration of the findings for your population as compared with the urban average, Philadelphia stood above the urban average for drug addiction, epilepsy, dementia precox; but especially for chronic infections of the upper respiratory passages and ears, namely, otitis media, sinusitis, chronic rhinitis, emphysema and hypertrophied tonsils; for organic and functional

heart diseases, such as valvular heart disease, cardiac hypertrophy and dilatation and functional cardiac disorders; for pointed- or short-shoe foot deformities, that is, hammertoe and hallux valgus; also for underweight and underheight.

It stood below the urban average for tuberculosis, venereal diseases, curvature of the spine and rickets, arthritis, goiter, obesity, alcoholism, refractive errors, defective hearing, diseases and disorders of the veins, defective and deficient teeth, hernia, relaxed inguinal rings; for certain nervous and mental disorders other than epilepsy and dementia precox, namely, neurasthenia, neurocirculatory asthenia, constitutional psychopathic state, mental deficiency; for the majority of the acquired deformities or losses of extremities, such as flatfoot, malunion of fractures, loss of extremities, ankylosis of joints, loss of fingers, deformities of the hand and defective physical development.

Some of the defects mentioned are obviously of greater importance from a military standpoint than from that of the ordinary demands of civil life. Practically all of them are, however, of some importance even to those who do not expect to engage in arduous physical exercise or labor. For example, a man with a pronounced degree of flatfoot, even though he may be able to carry on and to maintain himself and family in civil life, is surely inconvenienced if not actually handicapped by it; certain it is that his pleasure in life is lessened thereby.

We believe in frequent and thorough physical surveys. Many abnormal conditions, if detected during the early stages, can be corrected or further progress prevented. How many have been hopelessly crippled in the past by chronic joint conditions which could have been prevented by the early removal of focal infection around the teeth, tonsils, etc? How many have been rendered lifelong invalids by chronic heart diseases, which likewise could have been prevented or held in obeyance by careful attention during convalescence, removal of focal infection etc.? And may not the care and advice of a trained psychiatrist often prevent the development of serious nervous or mental conditions which incapacitate the patient even more than crippled joints or a damaged heart? Let us then take time to see that all is well

with us, and those of us who are medical men encourage our clientele to do likewise: For does not success and happiness in life in the full meaning of the words depend very largely upon our having a sound mind in a healthy, well-regulated body?

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DISCUSSION

Dr. George W. Norris: When I was asked to discuss this paper I felt rather hesitant as to my ability to do so. After listening to it this evening I feel very much more so. To begin with, it is a paper of statistics which suggest thoughts innumerable, and which would really require careful thought and study, in order to make any intelligent criticism or suggestion. I found it rather difficult to retain the figures quoted. The impression I got was there was plenty of room for pessimism in regard to the state of the nation. No one who has regard for the national welfare can help but be pessimistic when they begin to realize what is going on around us. As I gathered from Major Love's paper, Philadelphia was not so bad, contrasted with other cities, which in a small way was comforting, and yet is a thing which we cannot take very much comfort out of because of our many faults. I was interested in what he has to say in regard to the frequency of heart disease in individuals with small chests. I think the reason is rather obvious when one comes to think of it, because the heart cases discovered by the army were those which occur in early life in individuals with endocarditis and those who have had rheumatic fever and therefore are poorly developed. When first suggested it seemed a little startling because in advanced life we often associate heart disease with great big, healthy, deep-chested men.

A question which perhaps I can discuss a little better than the subject at large is, "What are we going to do about it" in relation to heart disease? I can perhaps answer that by telling you what we have done or at least started to do in the formation of a heart association. It attacks the problem from various angles. The main accomplishment is going to come through education—education of the public as to how heart disease is

acquired, how it may be avoided, and thoughts along that line. We have also gone about it by encouraging and working with the municipal health department in examination of children in order to detect early lesions. Another effort on our part is the establishment of heart clinics (of which I am proud to say we have twenty in Philadelphia and an additional five in the State of Pennsylvania), to which cases can be brought for proper diagnosis and suggestions for treatment. To these clinics the heart cases are referred from hospital wards, so that they can be kept under observation for a sufficiently long time after discharge from acute illness. We have also started a small convalescent home in the country, where some twenty or forty children are cared for after they have had endocarditis. This, of course, is a mere nothing compared to what the city of Philadelphia needs. All we hope to do with it is to create an example, with the hope that this municipality or some wealthy individual will found and endow some sort of a convalescent institution in the city which will be large enough to adequately take care of our cardiac cases. We are doing the sort of thing here which is being so well done by the Burke Foundation in New York City.

Dr. James Torrance Rugh: As Dr. Norris has said, one does approach the discussion of a paper of this kind and covering such a tremendous field with a great deal of trepidation. My work, naturally, in connection with the army concerned individuals after they had passed the draft board. In going through some of my papers last night I found a paper giving the results of the inspection (practically all personal inspection) of 47,471 soldiers, more especially for conditions of orthopedic type, and I found some wonderfully interesting data in this work. The thought occurred to me as Major Love was reading his paper, as to the variation in his statistics between the early examination of recruits and the late examinations. It is a fact that, as a result of experience, the examiners did infinitely better work later than they did earlier and it would be interesting to know the relative percentages of inefficients early in the draft and late in the draft by reason of the greater experience of the examining boards. I saw the results of this fact well exemplified in the various camps which I visited in comparison of the early methods of examination of recruits by men detailed for that purpose with those after the standardization of the examination as it was first begun by Rhoads at Camp Lee. The plan was first evolved there and then was standardized for all the camps in the country, and the examination of these recruits after January 1 was quite different from that which was given before January 1, that is, in the fall of 1917. A larger number of the unfit were picked up in these standardized camp examinations than were picked up before January 1.

Of course, my examinations were purely for orthopedic conditions, and even after these men had been picked over by the draft boards and regimental surgeons, I found, for instance, 46 per cent of all the men were passed as normal with regard to the feet, legs and spines. Of the remaining 54 per cent, there were of weak feet, 27.5 per cent; of flat feet, 1.3 per cent; of short heel tendons, 8.3 per cent. Short heel tendons in the male, perhaps you may not know, are almost always of the congenital type and may cause weak feet and flat feet and must always be reckoned with as a causative factor of disability in the feet. Many organizations had 12 to 15 per cent of this disturbance in the feet of the men, but it was not recognized by the ordinary examiner; it was only picked up by the specialists who conducted examinations in the various camps.

I am not really so despondent over the physical condition of the American young man of today. I am not even pessimistic from records such as we have heard. I have had a great deal to do with the cripple problem as it is being prosecuted at the present day. I am doing a tremendous amount of work in connection with it, and I want to say the thing that really impresses me in looking into the future, as to the unfits of the present generation and those who are to come, lies in the source of supply. We have not yet got to that point in our civilization where we are willing to attack the source. I mean that we are not willing to limit the individuals who shall marry and beget children. You take our state institutions, take the records of these individuals who fill them—they are the unfit from both the urban and the rural population. In an institution near our own city, a few years ago, there were two families of children, one containing six and the other nine, in both of which instances the parents were feebleminded. Go to Spring City, go to the Vineland state institution in New Jersey, and look up records of individuals who fill these institutions; there you will find the story of the unfit in the great majority of instances. That is the reason why you find so many feebleminded ones and why there were so many feebleminded ones in the late draft. When we are willing to attack the source, and limit the supply (and we have a perfect right to do it), then we will improve the percentage of efficients in our population. That will not take place, however, until the financiers of this country begin to feel the effect of it. We feel it now, but we feel it in a way that we do not consider. We feel it in our taxes, but when it begins to affect the manufacturing interests and the financial interests of the country you will then hear from them and something will be done; but until that time, unless there is a universal movement toward the improvement of the race by the elimination and the checking of the unfit, we are going to have a list of statistics in future generations very much like those of the present.

Colonel Alexander C. Abbott: I do not share the feeling of pessimism expressed by Colonel Norris. I am confident that by the time he and I are retired, as no longer serviceable, many of the generation that supplied the data we have just heard from the Surgeon General's office will be likewise in the discard.

But if we look around us we find much to justify optimism. We see in our centers of population activities among the young which, had they been in operation during the early days of the present generation, would have insured very different results from those outlined by Major Love.

I believe the advances in medical school inspection, the regular and repeated physical examinations conducted in our school and university gymnasiums and slowly beginning in our population at large, the encouragement of outdoor life and games, and the continued dissemination of information relating to health and disease, are making for a far better type. Almost none of these activities were in operation when the present generation was young.

Colonel Rugh has emphasized a point of very great importance. At the present stage of his idea we are assuming an attitude comparable to that taken on the question of venereal diseases a few years ago: The subject is unpleasant and not to be openly discussed in polite society. In the meantime we learn from trustworthy sources that neuroses, especially mental diseases, are increasing with alarming rapidity. Not only are the figures startling but the evidence as to their accuracy is convincing. As Colonel Rugh and Lieutenant Wilson have said, we have paid no attention to the sources of supply for these defectives and have ignored the underlying causes of their existence. Defectives are allowed freely to satisfy their sexual desires with the clear understanding that we foot the bills for the support of their worthless progeny.

Dr. Walter S. Cornell: The physical condition of the young men of America, as revealed by the draft-board examinations at the time of the World War, indicates the need for great improvement in our standard of national health.

Although the statistics of the Surgeon General's office have revealed those defects which were most prevalent, and those defects which most frequently caused military disability, the prevention of these physical defects and the prevention of the condition of low intelligence so frequently found are not simple propositions. Poor heredity, poor environment and poor previous health all contribute their depressing influences.

We have in all civilized communities an indefinite but considerable number who are mentally deficient. They number at least 1 per cent of the population. They are the progeny of weak human stock, and by our peculiar system of organized welfare work we nurse them along and

give them full leave to propagate degenerate individuals like themselves. In time of war our draft boards reject them as unfit for military service so that they stay at home while the best of our race goes out to fight and perhaps be killed. In primitive times war was the principal agency whereby the weak and unfit perished. Today the reverse is true. We must find some way to eliminate this element of weakness in our social fabric. Let us bear in mind that better plants and better animals are created through a process of natural or artificial selection whereby the better specimens are propagated, but just as definitely the poorer specimens are not propagated.

Owing to low educational and social standards existing in some of our states and in the countries of southeastern Europe which have contributed millions of recent immigrants we have a numerous group who are of low intelligence. Twenty-six per cent of the draft soldiers from South Carolina could not read or write. It is true that the majority of these were plantation negroes, but they were South Carolinians and Americans and they were counted as military personnel and they wore the army uniform.

The condition of malnutrition when it exists in a growing child is likely to leave its permanent mark. Stunted growth, stoop shoulders, decayed teeth and tuberculous infection are secondary consequences. To have healthy men we must have healthy children first. We cannot be born again, as far as our bodies are concerned.

As. Dr. Abbott has just said there must be certain definite causes for these definite physical defects found to exist so frequently. Certainly we need to reform our national diet, which is inadequate in proteins, vitamins and mineral salts, due to the use of white flour products, excessive sugar, and canned and predigested foods, as contrasted to whole grain, green vegetables, fruits and material that must be chewed. We must also ascertain the cause of diseased tonsils and adenoids now so prevalent, since they cause in turn the conditions of heart disease, deafness and other diseases. We need to adopt a more leisurely pace, since civilized man appears to be working toward a condition of nervous prostration in order that he may own an automobile and turn night into day.

As a Philadelphian I am glad that Pennsylvania did not stand at the bottom in the comparative statistics which have been gathered regarding the health of the men examined for army service, and I am glad that the city of Philadelphia showed slightly better than the average large city, and better than Chicago or Boston. It must be confessed that the factors which caused these differences were due to influences to which our public health agencies did not contribute much. The men of Kansas showed up best, because they had been raised in the open air, not in factories. From this let us learn our final lesson, that industry unless curbed, will take its toll of human lives and health unless intensive and

expensive counter-measures are taken. We must not create a civilization at the cost of human health and life.

Dr. George Wilson: Unfortunately Dr. Rugh has stolen most of my thunder. I do not see how he shunts himself off from the feet to the head, but neverthleless he did it. I think the first thing from the neuro-psychiatrist's point of view is the tremendous frequency, not only in our urban populations but in our rural. While it is true that the psychiatrists and alienists eliminated a large proportion on this side, still a tremendous number got to France, as everyone who got there knows, and a tremendous number remained, as I have learned in the Veterans' Bureau, where I have been working for three or four years. The frank mental cases, as dementia praecox and epilepsy, were usually picked up. If the draft boards did eliminate the constitutional inferiors and psychopathics, they missed a great many. Those men who before the war may have been able to fit in in some way, their experience in the war has rendered absolutely unable to adjust themselves, and they are the men who have the paranoid ideas about the Government and the way they were treated. As I say today, that is the great group that were damaged by the war more than the praecox who were picked up and eliminated before they got in the Army. The chief way to prevent this thing, from the nervous point of view, is to cut off the supply from the source. So far as I see, not only in the Veterans' Bureau, but in Philadelphia the great source of our mental cases is from Southern Europe. In my service in the Philadelphia Hospital last summer there were over 70 per cent of acute psychopathics who were born in southern Europe, showing the tremendous frequency in those coming from abroad to this country.

Major Love (closing): I have but little to add to the excellent discussions. The physical examinations which were made by the camp boards during the latter period of the draft were necessarily much more carefully done. Consequently, more defects were noted, but relatively fewer cases of flatfoot, which we attributed to the greater care exercised by orthopedists on the camp boards in recording only the pathological cases.

Some of us are very deeply concerned about the number of neuro-psychiatric cases which have developed. Is it not possible that, as a result of the great liberality of our Government and of the well-intentioned though frequently misdirected efforts of welfare societies, many neuro-psychiatric cases have been developed since the War? It is reported that in some instances well-meaning welfare workers have sought out ex-service men who were self-supporting and induced them to go to the hospital for some rather trivial condition; and that among them there were borderline cases who, after once being in a Government hospital and receiving compensation, were loath to return to their former status.

PANCREATIC ANOMALIES, THEIR MORPHOLOGY, PATHOLOGY AND CLINICAL HISTORY

The Alvarenga Prize Essay[1]

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SUMMARY

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II. Malformations.
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III. Clinical applications.
- *A.* Pancreatic insufficiency resulting from various anomalies.
- *B.* Pathological changes in pancreatic bladders.
- *C.* Annular pancreas and its results.
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- *E.* Duct variations and their problems.
- *F.* Mobile pancreas and hernia.
- *G.* Diverticulitis and its relationship to the pancreas.
- *H.* Congenital cystic disease of the pancreas.

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I. THE DEVELOPMENT OF THE PANCREAS

KNOWLEDGE of the development of the pancreas in the human embryo may be said to date from the year 1888, when C. Phisalix, in his *Etude d'un embryon humain de 10 millimetres*, described the presence of two separate outgrowths from the intestine, "one, superior and larger, the duct of which will become the accessory duct; the other, inferior and smaller, which corresponds with the canal of Wirsung." It has been definitely settled that the pancreas arises as an outgrowth from the intestinal tube during the early weeks of intrauterine life, in close relation to the hepatic diverticulum which precedes it by a short interval.

At least two processes or anlagen are described: (1) The ventral anlage, on a level with the hepatic diverticulum; (2) the dorsal anlage, proximal to the hepatic diverticulum.

Thyng states that: "The dorsal pancreas arises from the intestine distinctly anterior to the hepatic diverticulum." It is not at all unlikely that the dorsal anlage appears first, for Volker and Keibel and Elze have described such a structure only in embryos of 3 and 4 mm. respectively. Both anlagen have been described in specimens of 3 and 4 mm.

The ventral process is smaller than the dorsal and is situated in the inferior angle between the hepatic diverticulum and the intestine. The dorsal process is much shallower at first, but rapidly elongates into a duct, which soon shows signs of division and the formation of many small branches.

According to many writers, two ventral anlagen, right and left, are often found. Thus Débeyre reported such a condition in a human embryo of 4.5 mm. Helly believed that the left ventral anlage degenerated at an early period, totally disappearing by the fourth week. Other observers have thought that this process fuses with the right ventral anlage.

Many vertebrate embryos show this condition of paired ventral processes, whilst very occasionally a paired dorsal process is recorded. This latter variation has not been found in man.

As the ventral and dorsal anlage elongate, two phenomena

are going on: (1) Multiple division of the ducts, with formation of buds, at first solid, later hollowed out and containing central cells—alveoli; (2) rotation of the stomach and development of the duodenal loop, so that the ventral and dorsal anlagen become medial and lateral respectively.

The bile duct which has developed from the most proximal portion of the hepatic anlage now grows dorsally from its position on the right side of the intestine, and the ventral process accompanying it is brought into close relation with the dorsal process and by the third month has anastomosed with it. Hamburger found this anastomosis between the ventral and dorsal processes in a six weeks' embryo.

The ventral anlage thus forms a portion of the head of the pancreas and most of the uncinate process, whilst the dorsal anlage forms the remainder of the gland. The duct of the ventral process anastomoses with that of the dorsal process, and the continuous channel formed by the distal part of the duct of the dorsal process, the anastomosis and the duct of the ventral process constitutes the pancreatic duct of the adult. The proximal portion of the duct of the dorsal process is known as the accessory pancreatic duct of Santorini.

The youngest human embryo in which the islets of Langerhans have been observed was described by Pearce in 1903. The islands were situated only in the distal part of the pancreas and were represented by small groups of from ten to fifteen cells, in continuity with the ducts, with round and lightly staining nuclei and relatively abundant protoplasm which stained deeply with eosin. The islets had not close relationship to bloodvessels. Such an embryo was 54 mm. in length. By the third month a few islets are seen in the head of the pancreas and resemble those of the adult—being pale, in rows or anastomosing solid cords, with an intimate relationship to the capillaries. The cells are detached from the epithelial tubes or ducts at a variable time.

The development of the pancreas thus may be divided into several stages: (1) The appearance of the anlagen. (2) The formation of separate pancreatic tissue masses from the ventral

and dorsal anlage. (3) The fusion of two separate processes due to (*a*) rotation of the intestinal tube and (*b*) active growth of the ventral toward the dorsal process. (4) Development of the islets of Langerhans from the terminal duct and alveolar epithelium.

Should there be any interference in the usual sequence of events certain anomalies result, which will be considered in detail.

II. THE MALFORMATIONS

A. Anomalies of the Anlagen

1. Failure of One Anlage to Develop. Such an anomaly as this must be exceedingly uncommon, for apart from a case reported by Helly, in which an independent duct of Wirsung was not to be found, I have not been able to find any reference in the literature.

E. Zuckerkandl, writing in Nothnagel's *Handbook*, has reported a case of a pancreas with a solitary duct, corresponding to the ductus Santorini, the ductus choledochus opening alone into the duodenum.

It is possible that nondevelopment of one anlage may be the cause of certain types of congenital atrophy of the pancreas. Occasionally it has been reported that the accessory pancreatic duct has been absent, but there appears to be a tendency to look with suspicion on all such cases, perhaps unjustly.

Complete absence of the pancreas has been reported in association with congenital absence of the liver, stomach, spleen and peritoneum (Birnbaum).

2. Nonunion of the Anlagen. In the normal adult pancreas it is almost impossible anatomically to determine the division into two parts developed from the two primary processes. Occasionally, during routine dissection of the gland, one notices a very definite groove between the head and the remainder of the organ, so that the head appears as "flap" arising from the body. Sometimes there appears to be the slenderest of unions between the head and the body, and in these cases the accessory duct is usually larger than the pancreatic duct.

The main feature of nonunion of the ventral and dorsal processes is the persistence of the duct of the dorsal process as the main duct, opening into the duodenum at a normally situated papilla minor by a patent orifice. Such cases have been reported by Opie, Duval, Schirmer, Verneuil, Charpy, Helly, Baldwin and others. Baldwin has collected the various cases reported and finds 32 examples in the 381 recorded cases.

Two varieties of this nonunion of ducts seem to occur: (1) Those in which there is a persistence of the embryonic arrangement of the ducts, the accessory duct being larger than the pancreatic duct and draining the whole of the body and tail together with the proximal portion of the head of the pancreas; in my series of 100 cases I have not found an arrangement such as this. (2) Those in which there is a small accessory duct quite separate from the main pancreatic duct; I have noted several examples of this arrangement; Baldwin found 5 such arrangements in his 76 dissections. As the accessory duct in this variety of cases is usually very small and drains a limited portion of pancreatic tissue, it seems likely that failure of complete development of the dorsal anlage is the chief factor concerned.

3. Persistence of the Left Ventral Anlage. It has been pointed out when discussing the development of the pancreas that there is some evidence in favor of two ventral anlagen, right and left. Certain anomalies can be easily explained on such a basis, although whether such an explanation will prove correct in the light of future embryological research remains to be proved. The anomalies referred to are:

(*a*) *Pancreatic Bladders.* Pancreatic bladders have been described in the domestic cat only. A typical example consists of a distal bladder drained by a duct, the proximal half of which, embedded in a lobe in the pancreas, opens into the main pancreatic duct before it gives off any branches, or else close to this portion or one of its primary divisions. One of Boyden's cases opened into the duodenum through an orifice below the opening of the normal hepatic and pancreatic ducts. The bladder is usually embedded in the right lobe of the liver, close to the

gall bladder, often to the left. The duct may be situated alongside the common bile duct and both the pancreatic bladder and the gall bladder may be supplied by branches of the cystic artery. Sometimes the duct is developed in a long, slender lobe of pancreatic tissue quite separate from the main gland though covered by the same peritoneal investment, *e. g.*, Boyden's case. Boyden has collected all the cases described, and classifies them as follows: 15 cases derived either from an aberrant left lobe of the ventral pancreas or possibly from a subdivided gall bladder; 4 cases of an accessory lobe of pancreatic tissue paralleling the course of the ductus choledochus (incomplete cases of pancreatic bladders); 1 case of pancreatic bladder derived unquestionably from an accessory duodenal pancreas. There appears to be some evidence that the cysts are inherited, for 3 out of 5 of Miller's specimens were found in cats from the same farm (Dresbach). Two explanations of the mode of development have been given:

1. W. S. Miller thinks that the pancreatic bladder of the adult represents a persistence of the left ventral pancreas, which undergoes an aberrant elongation in the direction of the gall bladder. The terminal portion of this lobe then becomes dilated, forming the bladder, and the proximal part atrophies, leaving only a duct.

2. F. T. Lewis regards pancreatic bladders as arising through subdivisions of the hepatic diverticulum, *i. e.*, extreme instances of double gall bladder emptying into a subdivided cystic and common bile ducta.

In the case reported by Boyden, which opened into the duodenum separately, the bladder probably arose from an accessory pancreas well down on the duodenum.

Bremer thinks that: "Neither of the two theories as to the cause of pancreatic bladders will explain all the known cases." He suggests that the shape and character of the ducts of the liver in the cat embryo might explain a tendency to division by longitudinal splitting along the line of separation of hepatic and pancreatic elements, thus giving a reason for the formation of pancreatic bladders in this animal. But Bremer has to admit that this explanation will not fit cases such as that described by Boyden, where aberrant growths must be considered seriously.

(*b*) *Annular Pancreas.* In this condition the pancreas forms a complete or partial ring around the descending part of the duodenum, the remainder of the pancreas usually being normal. J. H. Anderson has recently collected most of the cases described, so that it is not proposed to discuss this abnormality at length.

Reference might be made to a case described by Bell, in which the pancreas completely encircled the second part of the duodenum from behind forward, in apposition with the pancreatic tissue but not in continuity. Associated with this was a vertical process, 28 mm. long, descending along the medial surface of the

FIG. 1.– Annular pancreas (Dr. J. H. Anderson's case). *An. P.*, annular pancreas; *D*, duodenum; *P*, pancreas.

second part of the duodenum and passing anteriorly to the transverse part. Other developmental abnormalities, *e. g.*, defective interventricular septum of heart, were present. Baldwin explains annular pancreas as being due to the persistence of the left ventral anlage, which grows to the left, ventral to the duodenum, to join the main mass of pancreatic tissue. Excessive growth of the right ventral anlage in a similar direction might also produce the same result.

4. SEPARATION OF THE VENTRAL ANLAGE FROM THE HEPATIC ANLAGE. This abnormality is discussed in the section, "Anomalies of the Ducts."

B. Accessory Pancreas

An accessory pancreas is a collection of pancreatic tissue situated in some abnormal position. The first two examples were described by Klob in 1859—one in the stomach wall near the middle of the greater curvature, the other in the jejunum, 4 inches from the duodenum. Zenker, in 1861, collected 6 examples, all of which had a duct opening into the intestine. Cases have been collected subsequently by Glinski, Opie, Thorel, Ruediger, Mouchet, Kremer, Weidmann and Benjamin.

Situation. The various sites for accessory pancreas in man include the following:

1. Wall of stomach: according to Opie and Gardiner about one-third of cases are found in the stomach near the pylorus.
2. Wall of duodenum, above or below the pancreas.
3. Wall of jejunum.
4. Wall of ileum: Zenker described 1 example situated 54 cm. from the ileocecal valve.
5. Diverticulum of stomach: described by Kaufmann and Albrecht and Arzt.
6. Diverticulum of jejunum: described by Kaufmann and Albrecht and Arzt.
7. Diverticulum of ileum: Weidmann says that 18 per cent of cases are found in diverticula.
8. Meckel's diverticulum, as in case described by Hulst.
9. Umbilical fistula: Wright found an accessory pancreas in a congenital umbilical fistula in a child aged twelve years.
10. Mesenteric fat: Thorel described a case in the mesentery of the upper third of the duodenum, with another in the wall of the jejunum, three fingers' breadth distant.
11. Omental fat: described by Warthin.

Mann has lately described the first example of an accessory pancreatic nodule in the gall-bladder wall. The specimen is unique in several ways, seeing that it is the third accessory pancreas found in the dog. It was situated on the inferior surface of the gall bladder and extended backward from the beginning of the neck. It communicated with the mucosa of the gall bladder

by several ducts, but had no connection with the main pancreas. The two other cases found in the dog were also reported by Mann and were situated 32 and 6 cm. from the pylorus respectively.

12. Splenic capsule: Weidmann found a collection of pancreatic elements in the capsule of the spleen, with a well-developed duct system and typical islets.

13. Hilus of spleen: a case was reported by Ellis.

Structure. Accessory pancreatic nodules have the ordinary structure of pancreatic tissue and, as Kremer says: "*Rien ne s'oppose à ce qu'ils exercent leur fonction sécrètoire comme le pancréas normal.*" They are most commonly found on the ventral surface of the gastrointestinal tract and may penetrate the muscularis or may be limited to the submucosa or adventitious layer.

Typical pancreatic acinar tissue is present. There are usually acinar and centroacinar cells, with numerous ducts. Most observers agree that well-developed islets of Langerhans are usually present, although Letulle denies this.

Nodules may be single or double, examples of the last-named being reported by Opie, Glinski and Thorel. I am not aware of a case with more than two nodules being recorded, although many of the lower animals have multiple pancreatic nodules in place of one main gland. Variations in size are frequent: Opie states that they are usually about 1 cm. in diameter, although several recorded cases have had diameters of several centimeters, and the two examples in the Pathological Museum of the Melbourne University are each well above this average. Weidmann gives a variation in size of 0.4 to 9 cm.

Frequency. Letulle found 6 examples in 200 autopsies; Opie, 10 in 1800 autopsies; Mouchet, 5 in 200 autopsies; Kremer, 6 in 467 cases. These results together give an average of about 1 example in every 99 postmortem examinations.

Pathological Changes. These may be classified as follows:

1. Pathological changes in the accessory pancreas itself.
2. Pathological changes associated with accessory pancreas.

In the first group the following have been described:

Acute Inflammation of the Nodule. Carwardine and Rendle Short reported such a case in which there was extreme inflamma-

tion of the nodule and surrounding jejunum, with symptoms of high acute intestinal obstruction.

Chronic Interstitial Inflammation of the Nodule. Opie found 6 examples of this in 35 cases. He suggests that it may follow occlusion of the ducts. Mayo Robson has also described this condition.

Malignant Change. This has been described by Eloesser, Branham and Ellis.

Fat Necrosis. Warthin found fat necrosis present in his case, situated in the omentum.

Pancreatic Bladders. These have already been dealt with.

In the second group the changes are mainly from mechanical alteration in the walls of the alimentary canal. The frequent association between accessory pancreas and diverticula of the intestine or stomach has been discussed by Neumann, Nauwerk and Hansemann, who think that these diverticula are the result of traction exerted by the aberrant nodule causing a defect in the muscle coat, so that pressure in the intestine during peristalsis causes a hernial protrusion of the mucosa and submucosa through the muscularis.

Cecchini has described a condition of gastroptosis resulting from the presence of an accessory pancreas.

Ellis found a fibroma in the wall of the stomach associated with aberrant pancreas.

Alburger's case had multiple cutaneous lipomata.

Kremer points out that accessory nodules are not necessarily affected by disease at the same time as the main gland, and suggests that in diabetes mellitus the accessory gland may to a certain extent replace the internal secretion of the diseased organ, as islets of Langerhans are present in most cases.

Origin. Zenker thought that an abnormal anlage arising near to the primitive pancreatic outgrowth of the intestinal tract might, through subsequent separation by longitudinal growth of the intestine, produce such a nodule.

Glinski directed attention to the development of the pancreas from more than one rudimentary outgrowth of the intestine, and suggested that a double dorsal anlage might be the cause of an

aberrant growth in the stomach wall. Persistence of one of the two ventral outgrowths would account for one in the jejunum. But, as Opie points out, two aberrant glands above the pancreas would need a triple dorsal anlage, and such multiple anlagen have not been found in any vertebrates.

Opie suggests that embryonic buds of gland tissue may make their way into the wall of the intestine at an early period and be carried from the remainder of the gland by the longitudinal growth of the intestine.

Warthin has suggested that projecting buds of the sprouting pancreas are snared off by the surrounding mesoderm and carried off into aberrant situations. Adami says that the cells must be so far differentiated that they have become unipotential, *i. e.*, capable of producing only one type of tissue (quoted from Weidmann).

Lewis and Thyng found "knob-like intestinal diverticula" occurring regularly in human embryos, and suggested that they were the probable source of occasional accessory pancreas, for they may give rise to glandular tissue.

Two Additional Cases. Two examples of accessory pancreas are in the Pathological Museum of the Melbourne University, both being collected by Sir Harry Allen.

Example I. A small firm nodule, 3 cm. maximum diameter, is situated deeply in the wall of the duodenum very close to the pylorus, opposite the head of the pancreas. It resembles pancreatic tissue in color, consistence and surface appearance. No special bloodvessels are seen in connection. In the tail of the pancreas is a very soft sarcomatous nodule, well defined, not encapsulated, with marked central softening. There has been some infiltration of the pancreatic tissue in the immediate neighborhood of the nodule. Microscopically the accessory nodule consists of normal pancreatic tissue situated between bands of smooth muscle and fibrous tissue; the acinar cells stain deeply; ducts are numerous, small, with well-defined epithelium; there is an excretory duct; islets of Langerhans are present, though few in number. The specimen was obtained from a male, aged nineteen years. This case is of special interest on account of

the following points: (1) Its size, which is well above the average given by Opie; (2) an associated sarcomatous nodule in the tail of the pancreas, reported for the first time; (3) an extensive duct system.

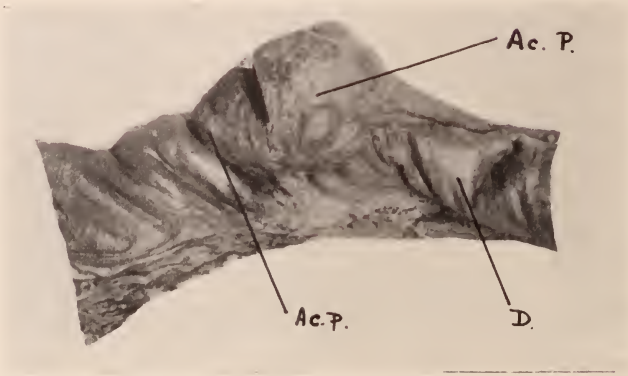


Fig. 2.—Accessory pancreas in jejunum. *Ac.P.*, accessory pancreas; *D*, jejunum.

Example II (Fig. 2). A mass about 4 to 5 cm. in maximum diameter is situated on the antimesenteric surface of the first coil of the jejunum. It resembles the pancreas in color and general appearance. It is markedly lobulated, closely adherent and, passing into the gut wall, lifting up the peritoneal lining, forming folds, along one of which courses a small vessel. The pancreas itself appears normal; the head shows marked lobulation. Microscopically normal pancreatic tissue with deeply staining acinar cells and thick-walled ducts is to be seen; fine bands of mature connective tissue spread between acini, but nowhere are very marked; bloodvessels are not numerous; islets of Langerhans are present. There is no evidence of deep penetration of the bowel wall, for connective tissue and fat surround the mass, with no sign of muscle or mucosa. No excretory duct could be detected. This case is of special interest on account of the following points: (1) Its situation in the jejunum; (2) its size; (3) its extensive duct system, the ducts presenting thick walls; (4) its relation to the bowel wall. The specimen was from a male, aged forty years.

The following table gives a list of the cases of accessory pancreas in the jejunum that have been reported:

CASES OF ACCESSORY PANCREAS IN THE JEJUNUM

1. Klob (1859)	In posterior wall	....	Numerous small ducts.
2. Montgomery (1860)	Upper part, beneath the serosa	True pancreatic tissue; 1 in. diameter	No duct.
3. Zenker (1861)	First coil, the jejunum close to duodenum	True pancreatic tissue	Duct opening into intestine.
4. Zenker (1861)	First coil, the jejunum close to duodenum	True pancreatic tissue	Duct opening into intestine.
5. Zenker (1861)	First coil, jejunum 16 cm. from duodenum	True pancreatic tissue	Duct opening into intestine.
6. Zenker (1861)	Two accessory glands; one 16 cm., the other 48 cm., from duodenojejunal junction	True pancreatic tissue	Duct opening into intestine.
7. Hansemann (1896)	Tip of diverticulum of upper part of jejunum;	Not described.	
8. Nicholis (1900)	Wall of commencement of jejunum	Multiple lobules of pancreatic tissue	Small excretory duct.
9. Opie (1903)	Submucosa of jejunum, 11 cm. below duodenum	Adenomatous; interstitial inflammation	Excretory duct not determined.
10. Opie (1903)	Submucosa, 4 cm. from duodenum	No acini; dense fibrous stroma	Ducts.
11. Ruediger (1903)	Muscular coat of wall, 15 cm. from the duodenum	True pancreatic tissue with islets	Numerous smal ducts.
12. Thorel (1903)	Middle of jejunum	Acini; no islets	Excretory duct.
13. Thorel (1903)	Middle of jejunum	Adenomyoma	3 excretory ducts.
14. Thorel (1903)	Middle of jejunum	Adenomyoma	1 excretory duct.
15. Thorel (1903)	Two accessory nodules; one in upper third, other nearby in mesentery	True pancreatic tissue with islets	No excretory duct.
16. Turner (1904)	30 cm. from duodenum	No islets; acini.	
17. Alburger (1904)	A few cm. below beginning of jejunum, in mucosa	Islets and acini	Dilated ducts.
18. Longcope (1904)	Size of almond;	Not described.	
19. Lewis (1905)	0.85 cm. below duodenum in muscularis	True pancreatic tissue	Ducts.
20. Cawardine (1908)	2 inches from duodenojejunal flexure.		
21. Short (1913)	Caused acute pancreatitis and jejunitis.		
22. Benjamin (1918)	Short distance from duodenojejunal flexure	Adenoma; malignant?	No ducts.
23. Path. School, Melbourne (1923)	First coil of jejunum	True pancreatic tissue; islets	Thick-walled ducts; no excretory duct.

In considering these two specimens there is one point of special interest, viz.: The nodule in the duodenum is situated deeply in the wall and has an excretory duct, whilst the jejunal nodule is situated on the external surface of the gut with practically no deep penetration, and as far as could be determined has no excretory duct.

Apparently the mode of origin differs in these two cases. The explanation put forward by Zenker and Glinski probably applies to the duodenal case, whilst that of Opie seems to be the most rational for the jejunal example.

C. Horizontal and Vertical Pancreas

The shape of the pancreas varies greatly in different species. In the ox and sheep it is irregularly quadrilateral. In the horse it is very irregular, although roughly triangular. The pancreas of the dog is V-shaped, with two long, narrow branches which meet at an acute angle; the right branch passes down along the duodenum; the left branch is attached to the peritoneal surface of the stomach. In the cat the pancreas has two processes, one extending along the duodenum, the other along the stomach; the two meeting at nearly a right angle.

Cases have been described in man which indicates a reversion on the part of the pancreas to a lower type.

Carnot, in 1908, was the first to describe such a case. His specimen possessed a head, a horizontal process 10 cm. long, resembling the body and tail of the normal pancreas, and a vertical process 12 cm. long extending downward from the head along the duodenum.

Neve, as quoted by Bell, mentioned extra tail-lobes. Bell in a recent paper described 2 cases. In 1 the pancreas completely encircled the second part of the duodenum from behind forward, in apposition with pancreatic tissue but not in continuity. The horizontal portion resembled the normal pancreatic body and tail and was 51 mm. in length. A vertical process 28 mm. long descended along the medial surface of the second part of the

duodenum and passed anterior to the transverse part. The common bile duct opened into the duodenum with the pancreatic duct from the horizontal and vertical processes. The annular portion possessed a separate duct opening into the duodenum slightly above and posterior to the ampulla of Vater.

In the other case the small intestine joined the posterior wall of the stomach in the midline, opening into the stomach cavity by a slit-like orifice 5.5 cm. from the pyloric end of the stomach. The pyloric end had the form of a blind diverticulum, into which the common bile duct opened and the horizontal and vertical pancreatic processes met upon this diverticulum. The vertical process extended downward, its lower extremity slightly enlarged and turned abruptly backward. The duct from the vertical process led in conjunction with the common bile duct into the end of the diverticulum, whilst the duct from the horizontal process opened into the superior wall of the diverticulum.

An interesting feature of both cases was the presence of associated developmental abnormalities which included abnormally shaped liver; funnel-shaped diverticulum from the posterior wall of the stomach, attached to the meninges through an anterior spina bifida; posterior spina bifida; intraspinal pons, medulla and rudimentary cerebellum; absence of islands of Reil, tentorium cerebelli, pineal body, aqueduct of Sylvius and corpora quadrigemina; abnormalities of the heart; defect in the diaphragm; absence of greater omentum; bifurcated Meckel's diverticulum; abnormal arrangement of small and large intestines; undescended testicles; talipes varus.

D. Transpositions

In cases of complete transposition of the viscera the pancreas, together with the other organs of the abdominal cavity, is placed on the right side of the body. Birnbaum says that congenital displacements of the pancreas are uncommon but have been observed in diaphragmatic herniæ (in 27 cases out of 276 collected by Lacher) and umbilical herniæ. Rose recorded a case of umbilical

hernia containing the pancreas in a woman aged sixty-four years. The pancreas may be movable, either associated with gastroptosis (Cecchini) or with wandering spleen. Klebs states that the pancreas may be pushed downward by tight lacing and that retroperitoneal tumors and aneurysms of the adjacent vessels may carry it upward.

E. Anomalies of the Ducts

This section is based upon the dissection of 100 pancreases obtained from the postmortem room. In nearly all of the cases the subjects were adults and died from some condition other than pancreatic. The specimens were as far as possible consecutive.

A study of the embryology of the pancreas makes it apparent that abnormalities of the ducts might easily occur. Judging from the results of this investigation and from a study of other observers' results, anomalies of the ducts are not at all uncommon. Several of the more gross, and therefore more uncommon, findings have already been mentioned. The various problems touched upon in this study were:

1. The relationship of the common bile duct to the pancreas.
2. The position of the pancreatic duct within the pancreas.
3. The relationship of the pancreatic duct to the common bile duct.
4. The occurrence of the ampulla of Vater and the papilla of the common bile duct and duct of Santorini.
5. The duct of Santorini in its relationship to the pancreatic duct and the duodenum.

I have here to express my indebtedness to W. M. Baldwin's paper on the "Pancreatic Ducts in Man" for the comparative side of the question.

1. Relationship of Common Bile Duct to the Pancreas. In 69 per cent of the cases the common bile duct was found within the substance of the head of the pancreas surrounded by pancreatic tissue. In 31 per cent of the cases the common bile duct was

situated on the posterior surface of the gland in a fibrous groove, entering the pancreas only at its termination.

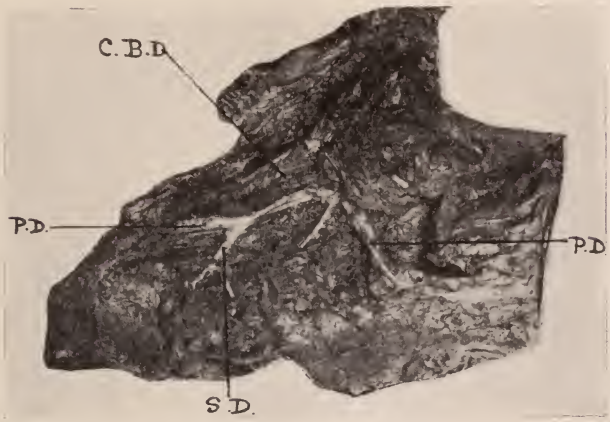


Fig. 3.—Commonest arrangement of ducts. Duct of Santorini turned caudally, with a portion of pancreatic tissue. *C.B.D.*, common bile duct; *P.D.*, pancreatic duct; *S.D.*, duct of Santorini.

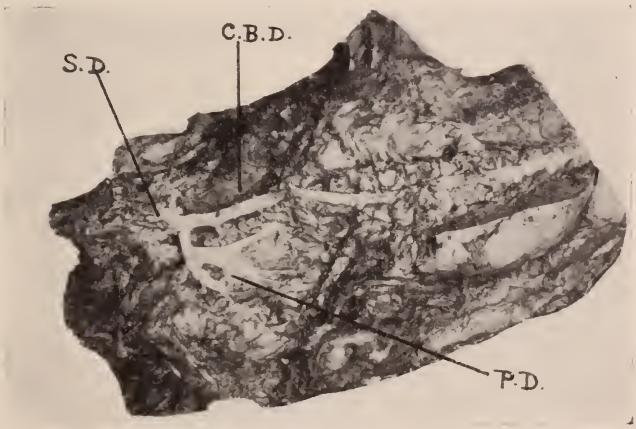


Fig. 4.—Spiral pancreatic duct.

According to Helly, the common bile duct is completely embraced by the pancreas in 62 per cent of bodies, and lies in a deep groove in the remaining 38 per cent.

Bunger, in an examination of 58 subjects, found that in 25 per cent the duct ran in a groove and in 75 per cent was entirely enclosed in pancreatic tissue.

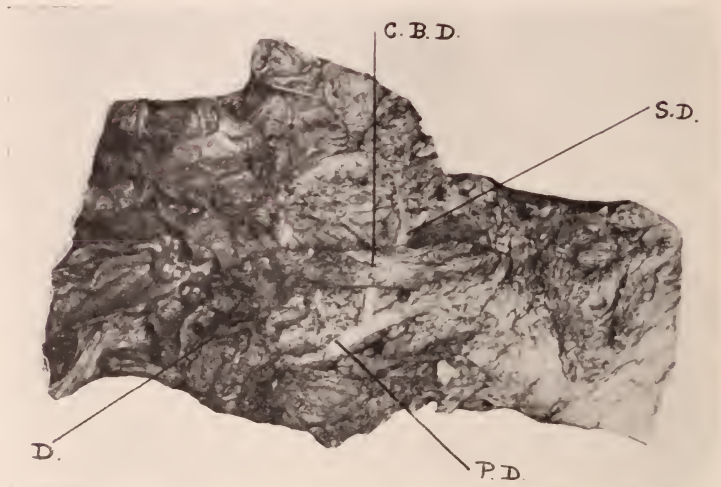


Fig. 5.—Separation of ducts (Class B). *C.B.D.*, common bile duct; *P.D.*, pancreatic duct; *S.D.*, duct of Santorini; *D*, duodenum.

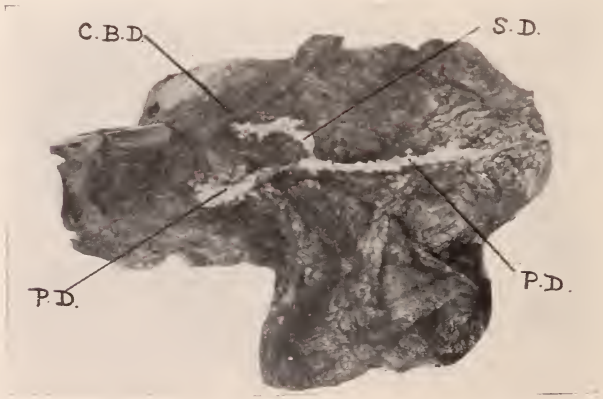


Fig. 6.—Separation of ducts (Class C).

Wyss found the common bile duct surrounded by the tissue of the gland in 31.7 per cent and situated on the posterior surface

of the head in 68.1 per cent, but his series consisted of 22 cases only.

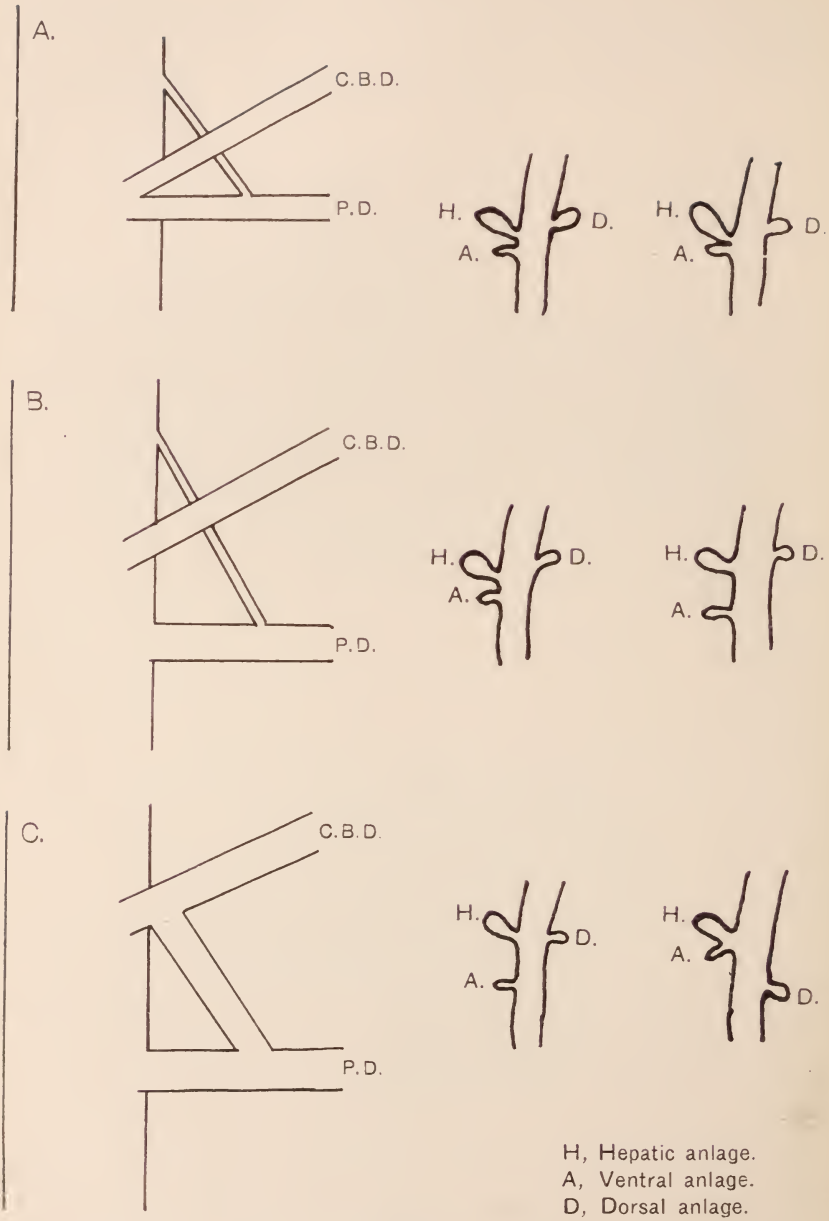
	Common bile duct situated		Number of cases examined.
	within pancreas.	outside pancreas.	
Helly	62.0 per cent	38.0 per cent	
Wyss	31.7 "	68.1 "	22
Bunger	75.0 "	25.0 "	58
Cameron	69.0 "	31.0 "	100

2. The Position of the Pancreatic Duct Within the Pancreas. In 80 per cent of cases the pancreatic duct was situated near the posterior surface of the pancreas; in 20 per cent of cases it was nearer the anterior surface of the pancreas or situated about the center of the gland.

3. The Relationship of the Pancreatic Duct to the Common Bile Duct. In 81 per cent of cases the pancreatic duct united with the common bile duct to form an ampulla of Vater; in 19 per cent of cases the pancreatic duct was separated from the common bile duct. As a rule, the pancreatic duct was situated in a slightly higher plane than the common bile duct. A typical spiral arrangement of the pancreatic duct as figured by Baldwin was found in 1 case. Various degrees of separation were noticed and could be grouped as follows:

A. Cases in which the common bile duct and pancreatic duct open into the duodenum side by side, usually at the summit of a papilla, but quite definitely separated from each other by a thin wall; in my series this was found in 10 per cent of cases.

B. Cases in which the orifice of the pancreatic duct was situated at a distance varying from 0.5 to 4 cm. caudal to that of the common bile duct, the accessory pancreatic duct passing anterior to the common bile duct, to end in the duodenum proximal to the common bile duct's termination, or else terminating in the pancreatic substance proximal to the common bile duct. Seven per cent of cases showed this variety of separation; of these, two presented pancreatic ducts which could not be completely traced to the duodenum, although the portion of duct present ran caudal to the common bile duct, in the direction of the duodenum.



H, Hepatic anlage.
A, Ventral anlage.
D, Dorsal anlage.

Fig. 7

C. Cases in which the pancreatic duct terminated about 2 cm. caudal to the termination of the common bile duct, but the accessory pancreatic duct ran proximally to unite with the common bile duct to open into the duodenum; this was present in 2 per cent of cases.

Several explanations present themselves for these variations:

Class A. Probably in these cases the ventral anlage arose either as a process quite distinct from the hepatic anlage, or else it was budded off from the latter extremely close to the duodenum.

Class B. In these cases either the ventral anlage arose from the hepatic anlage close to the duodenum and during growth of the latter was separated from the hepatic anlage, or else it arose as a bud from the duodenum at a definite distance from the hepatic anlage. The dorsal anlage, it is to be presumed, arose in the ordinary way.

Class C. This type is very difficult to explain, but the following explanations may be suggested:

1. The dorsal anlage arose exactly opposite to the hepatic diverticulum, the ventral anlage much caudally. By growth of the diverticula and rotation of the gut the hepatic and dorsal anlagen united, the ventral anlage joining the dorsal at a later date.

2. The dorsal anlage arose at a level distal to the hepatic and ventral anlagen and subsequently united with the ventral. In this case what has been described as the termination of the pancreatic duct would be the accessory duct opening into the duodenum at a level caudal to the combined opening of the common bile duct and pancreatic duct.

It is interesting to note that Charpy has figured an adult pancreas which shows the duct of the dorsal pancreas opening into the duodenum lower than the bile duct. The ducts had not united. His also described cases with the dorsal pancreas opposite and caudal to the bile duct.

The following is a summary of various observers' findings in regard to this particular problem:

Common Bile Duct and Pancreatic Duct

	Ducts unite.	Ducts do not unite.
Bernard	?	1
Laguesse	?	1
Schirmer	25	22
Opie	89	11
Letulle	9	12
Baldwin	70	20
Cameron	81	19

4. The Occurrence of the Ampulla of Vater and the Papilla of the Common Bile Duct and Duct of Santorini. The results may be summarized as follows:

Ampulla and papilla both present	52 per cent
Ampilla present only	18 "
Papilla present only	21 "
No ampulla, no papilla	9 "
	100 per cent
Total number of cases with an ampulla	70 per cent

A papilla was present at the termination of the accessory pancreatic duct in 100 per cent of cases.

Baldwin concludes from a study of his own cases and of the literature that there is an ampulla in 74.2 per cent of bodies. It will be seen that the result in this investigation agrees remarkably with Baldwin's figure.

The following table gives a summary of the frequency of the minor papilla:

	Number of cases examined.	Minor papilla present.
Schirmer	104	103
Helly	50	47
Charpy	30	29
Verneuil	20	20
Baldwin	100	100
Cameron	100	100

Four specimens of three papillæ have been reported: Schirmer, 1; Letulle, 1; Rolleston and Fenton, 1; Baldwin, 1.

5. The Duct of Santorini in Its Relationship to the Pancreatic Duct and the Duodenum. In 90 per cent of cases the duct of Santorini was very small. In 10 per cent it was

larger than or as large as the main duct. In 77 per cent of my cases a direct communication with the duodenum could be determined, although it is not claimed that this expresses an estimate of functional communication. Probably in the remainder of the cases there was an extremely fine process uniting the main duct radicle with the duodenum.

The main pancreatic duct united with the accessory duct in 94 per cent of cases, there being no junction in 6 per cent. In these latter there was a very definite communication with the duodenum. In every example an accessory pancreatic duct could be found.

The following tables give an account of the various investigations on this subject:

Accessory Pancreatic Duct Larger than Main Duct

	Specimens examined.	Inversions.
Schirmer	104	3
Charpy	30	3
Bernard	?	1
Morel and Duval	?	1
Opie	100	11
Bimar	?	1
Moyse	?	1
Baldwin	76	3
Cameron	100	10

Relation of Main Pancreatic Duct to Accessory Duct

	Number of cases examined.	Junction.
Schirmer	104	97
Charpy	30	28
Duval	?	All except 1
Helly	50	48
Verneuil	20	20
Opie	100	90
Baldwin	76	66
Cameron	100	94

The Accessory Duct

	Present.	Absent.
Schirmer	101	3
Charpy	29	1
Helly	50	0
Verneuil	20	0
Hamburger	50 +	0
Sappey	17	0
Opie	100	0
Baldwin	76	0
Cameron	100	0

F. Duodenal Diverticula and the Pancreas

Duodenal diverticula are by no means uncommon: thus Baldwin observed 15 cases in 105 cadavers; Linsmayer, 45 in a study of 1367 postmortem examinations. Of the 57 cases recorded the distribution has been: 11 cases in first part of duodenum; 2 cases in both first and second parts; 41 cases in the second part; 3 cases in the third part.

Nearly all are found in elderly people. Davis found that 16 per cent of duodenal diverticula occurred in subjects under fifty years, 37 per cent between fifty and sixty years and 47 per cent above sixty years of age. Wilkie found that in 26 cases 17 were in males and 9 were in females.

The size of such diverticula varies from that of a linseed to that of a hen's egg (Buschi). The structure is that of the duodenal mucosa with the muscularis, mucosæ and frequently some fibers, often atrophic, from the outer muscular layer.

Various theories have been put forward as to the origin of these diverticula:

1. That they are congenital in origin. Wilkie suggests the following reasons for this view: "(*a*) The duodenum in the course of normal development gives off hepatic and pancreatic buds; consequently developmental anomalies might be expected to occur more frequently in this than in other regions of the intestinal tract. (*b*) The observation of Lewis and Thyng showed that during early fetal life diverticula are often met with in the upper reaches of the small intestines, particularly in the duodenum. (*c*) An accessory pancreas is occasionally observed in or on the wall of such a diverticulum. (*d*) The case reported by Shaw, where in a newborn infant there were found both a diverticulum and a congenital occlusion of duodenum. (*e*) In the cases recorded by Letulle and Falconer congenital diverticula of the esophagus and stomach, respectively, accompanied the duodenal diverticula. (*f*) Many of these diverticula abut on and even indent the head of the pancreas."

2. That they are caused by extrusion of weak parts of the duodenal wall, without gross disease. Perry and Shaw, as quoted by Spriggs, suggested that closure of the pylorus when the duodenum is contracting will cause a higher pressure than is likely to be produced elsewhere in the small intestine. Keith draws attention to the occurrence of diverticula near the termination of the common bile duct consisting of mucous membrane extruded at weak points in the musculature.

3. That they are caused by ulceration or other pathological processes involving the wall of the duodenum. Ross found fatty degeneration of the muscularis associated with a diverticulum; Graser noted relaxation of venous sheaths in association with circulating stasis; whilst Aschoff considered fatty infiltration of the intestinal wall as the cause of a diverticulum he described; Bell described cases with both fatty infiltration of the intestinal wall and venous congestion.

The pathological changes which may occur in such diverticula include:

1. Inflammation, as described by Bassett.

2. Pressure on the common bile duct: Bauer recorded a case of inflammation of a diverticulum at the site of the ampulla of Vater which produced biliary stasis with jaundice.

3. Pressure on common bile duct and pancreatic duct: Bell describes a case in which there was a marked chronic interstitial pancreatitis and slight periportal cirrhosis of the liver in association with a diverticulum at the major papilla. He suggests that distention of this diverticulum might have exerted pressure on the common bile duct and pancreatic duct. There was an associated generalized sclerosis.

In the course of my routine dissection of 100 pancreases I came across 3 examples of diverticula in the second part of the duodenum. Each of these was situated very close to the papilla major, being respectively proximal, caudal and posterior to it. In each case there was an ampulla of Vater as well as a papilla. In 1 case the pancreas was very fatty, but in the other examples the pancreas appeared normal. There was no abnormality in the

arrangement of the ducts except that in 1 case no union between the duct of Santorini and the pancreatic duct could be determined.

The maximum diameters varied from 1.5 to 3 cm. Each diverticulum communicated with the duodenum by a wide mouth through which the tip of the little finger could be inserted. The wall was composed of a continuation of the duodenal mucosa and some muscular fibers. There were no associated pathological changes except in 1 specimen where there was ulceration of the duodenum about 2.5 cm. from the pylorus, but well away from the diverticulum.

Microscopically 1 of the specimens showed marked fatty change in the duodenal wall, but the other specimens failed to reveal any change.

All 3 specimens were obtained from elderly males. (Fig. 8.)

Fig. 8.—Duodenal diverticulum in head of pancreas. *C.B.D.*, common bile duct; *P.D.*, pancreatic duct; *Divert.*, duodenal diverticulum.

G. Miscellaneous Anomalies

Under this heading we may include:

1. Pancreas Minus. In this there is a supernumerary lobule in the head of the pancreas, separated by a more or less marked constriction. The commonest variety is that in which a portion of the head, lying behind the mesenteric vessels, is divided from

the rest by a deep cleft to form the lesser pancreas. Occasionally this lobule may be firmly fixed to the pancreas, so enclosing the mesenteric vessels in a canal. Ahlfeld has suggested that this anomaly may be due to persistence of the left of the two ventral analagen.

2. Pancreas Divisum. Separation of the head or tail of the pancreas (Hyrtl) or division of the pancreas into two equal or unequal parts may occur (Oser).

3. Bifid Tail of the Pancreas.

4. Accessory Spleen in the Substance of the Pancreas. Such an accessory spleen may be found in the head of the pancreas or, as in the case described by Klobin, in the tail.

5. Congenital Cystic Disease of the Pancreas. This is exceedingly rare. Mayo Robson and Moynihan were able to collect 3 cases. Oser mentions a case of Thiroloix and Pasquier which showed a great resemblance to congenital cystic degeneration of the kidneys: The duct of Wirsung was permeable; the fluid filling the spaces was alkaline, light-colored and contained epithelial detritus and lymphoid cells with much albumin. The same authority refers to von Petrykowski's case, in which a cystic tumor of an adenomatous character was removed from a boy aged three and a half years. Cystic disease of the pancreas resembles that condition met with in other organs with which it is commonly associated.

III. CLINICAL APPLICATIONS

A. Pancreatic Insufficiency Resulting from Various Anomalies

Pancreatic insufficiency resulting from congenital anomalies of the pancreas must be very uncommon, for it is practically impossible to find any records of such a condition in the literature. There are several reasons for this. In the first place, deficiency of pancreatic tissue must be very great before the condition becomes

sufficiently obvious to be detected by the ordinary observer. Glycosuria is the chief sign which directs attention to the pancreas, and the admirable researches of Allen have shown that the amount of pancreas which is necessary in a dog to prevent glycosuria is small, since the survival of one-eighth to one-ninth of the gland is sufficient. Perhaps if a more systematic use of pancreatic functional tests together with careful examinations of the urine and feces were carried out, especially in infants, congenital insufficiencies would be more commonly detected. The condition known as "pancreatic infantilism," first described by Byron Bramwell, has been quoted as due to congenital atrophy of the pancreas, but this has not been definitely ascertained.

From an anatomical point of view, several causes of pancreatic insufficiency might be suggested:

1. Incomplete or arrested development of the pancreatic anlagen, with subsequent formation of a small amount of pancreatic tissue only.

2. Atrophy of the pancreatic ducts from some prenatal lesion, especially toxemias and syphilis.

3. Failure of the islets of Langerhans to develop.

Of these the only example recorded is that of congenital cystic disease where apparently there has been incomplete development of the anlagen or possibly some interference with the fetal pancreatic ducts. In such cases the pancreatic insufficiency appears to be of a low order and the condition is diagnosed only by postmortem examination or else detected at operation.

Nonunion of the anlagen does not necessarily produce pancreatic insufficiency, for there is no diminution of pancreatic tissue, the ducts communicate with the duodenum and are functionally active, and there is no arrest in the development of the islets of Langerhans. Any lesion, whether it be prenatal or postnatal, spreading from the duodenum or gall bladder would tend to be localized in one particular portion of the gland, so that there would be even less chance of insufficiency developing than with a normally developed pancreas.

B. Pathological Changes in Pancreatic Bladders

Although as yet pancreatic bladders appear to be unknown in human beings, it is of interest to consider their pathology. Several considerations present themselves. In the first place, they may arise from the ventral pancreatic anlage or from the hepatic diverticulum. Hence, as regards their nerve supply and vascular connections, one would expect them to conform to the corresponding nerve supply and vascular distribution of the organs with which they are associated. Hence the various protective phenomena which arise as the result of disease, especially referred pain, rigidity, tenderness, etc., would be characteristic either of pancreatic disease or else of hepatic and gall-bladder disturbance.

In the second place, the situation of pancreatic bladders corresponds very closely with that of the gall bladder, so that both would tend to be affected by similar pathological processes by direct extension. On the other hand, the pancreatic bladder would differ from the gall bladder in:

1. Its closer connection with pancreatic tissue, both anatomically and functionally. In several of the recorded cases active pancreatic tissue has been present in the walls, discharging pancreatic secretion into the cavity.

2. Its dissociation from the biliary system except for its connection with the common bile duct through the pancreatic duct.

It appears then that the symptoms and signs of a lesion of a pancreatic bladder would resemble those of a true pancreatic lesion in most cases. In a few the syndrome would approach that of a lesion of the gall bladder. The local signs in all cases would suggest local disease of the gall bladder. Although no evidence has been presented of obstruction of such a structure, whether from calculus or newgrowth, yet there is no reason why such a condition might not arise. Calculus formation should be determined by conditions similar to those determining pancreolithiasis, rather than cholelithiasis.

C. Annular Pancreas and Its Results

Annular pancreas is almost always found in males and produces, according to Anderson: (1) A constriction of the second part of the duodenum; (2) a dilatation of the duodenum cranial to the constriction. In some of the cases recorded this constriction has been very great, with extreme dilatation cranially, yet symptoms of obstruction appear to be extremely uncommon. As the remainder of the pancreas is usually normal, and the ducts, although showing alterations in their position, open quite freely into the duodenum, there is no disturbance in the function of this organ.

D. Accessory Pancreatic Lesions

Carwardine and Rendle Short, in their paper on "The Surgical Significance of Accessory Pancreas," state that such a condition may give trouble in four ways:

1. *Mechanical Alteration in the Walls of the Alimentary Canal.* (*a*) It may form a complete ring around the duodenum, similar to an annular pancreas, producing stenosis and obstruction. (*b*) It may give rise to a diverticulum, as described above. (*c*) A case of gastroptosis associated with accessory pancreas has been described by Cecchini.

2. *They are Liable to Acute Pancreatitis.* These authors report a case in which there was extreme inflammation of the wall of the surrounding jejunum and symptoms of high acute intestinal obstruction. Warthin's example, which was situated within the omentum, showed fat necrosis. Inflammation in an accessory pancreas may be primary, caused by spread of infective organisms from the bowel, either through the excretory duct or from a small erosion in the mucosa with lymphatic infection, or it may be secondary to a lesion of the gut wall.

3. *They may Develop Chronic Pancreatitis.* Reference has already been made to the cases reported by Mayo Robson and Opie. Presumably chronic inflammation may arise either from occlusion of the excretory ducts, as suggested by Opie, or from an

acute condition becoming chronic, as, for example, an acute catarrhal inflammation, or from a distant or neighboring focus, the means of infection being through the blood stream.

4. *They may Complicate the Diagnosis of the Cause of Abdominal Symptoms.* Thus Carwardine reported a case of malignant disease of the pylorus with an accessory pancreas in the wall of the jejunum, two inches from the duodenojejunal flexure.

In addition to these, I have been able to collect the following:

5. *They may be the Starting Point of Malignant Disease.* Such a change has been recorded by Eloesser, Branham and Ellis.

6. *They may be Associated with an Intussusception.* Benjamin recorded such a case where an accessory pancreas was found at the apex of an intussusception.

7. *They may Undergo Fat Necrosis.* This has already been referred to.

It must be remembered that such nodules are not necessarily affected by disease at the same time as the main gland, and Kremer suggests that in diabetes mellitus and in surgical diseases of the main gland the accessory gland may replace the former, especially as regards the internal secretion. From a study of this survey it will be seen that as regards clinical history many varieties of cases may be found. Symptoms include:

(*a*) Those of intestinal or gastric obstruction of all grades.

(*b*) Those of diverticulitis and intussusception.

(*c*) Those of gastroptosis.

(*d*) Those of acute inflammation of any portion of the small intestine and stomach.

(*e*) Those of acute pancreatitis.

(*f*) Those of malignant disease of any portion of the stomach and small intestine.

In the great majority of cases they are symptomless, being detected only during routine examination at autopsy.

The only practical importance of the horizontal and vertical pancreas is, so far as one can see, that it might be confused with a tumor of the pancreas, especially in a hasty examination during operation.

E. Duct Variations and Their Problems

The chief interest in duct variations lies in a consideration of their relationship to the etiology of pancreatitis. The figures obtained in my dissection of pancreases from 100 Australians correspond closely with other observers', especially those of Opie.

In 69 per cent of cases the common bile duct was situated within the pancreatic substance; in 31 per cent it was found on the posterior surface. Hence the common bile duct may be directly involved, either by pressure or by spread of infection, in 69 per cent of cases.

Mayo Robson and Cammidge have particularly stressed the importance of pressure on the common bile duct by congestion or swelling of the head of the pancreas. They suggest that many of the cases of so-called catarrhal jaundice, which commence as an extension from gastroduodenal catarrh or in the course of various ailments, are not unlikely dependent on catarrhal inflammation and swelling of the pancreas, leading to pressure on the bile ducts. "The so-called chronic catarrh of the bile ducts leading to persistent jaundice is nearly always due to chronic pancreatitis, the obstruction to the flow being outside and not inside the common duct."

Cammidge, in his address before the Royal Society of Medicine in 1910, said that of 53 cases of catarrhal jaundice 42 gave positive reactions to the "pancreatic" test.

The author has complete notes of 8 cases diagnosed as catarrhal jaundice in which a fairly complete examination of the pancreatic function was carried out. These are set out in the table on page 813.

In this small series 50 per cent of cases gave definite evidence of pancreatitis; 50 per cent showed negative pancreatic tests. The position may be stated as follows: In approximately two-thirds of all cases the anatomical arrangement of the common bile duct in the head of the pancreas is such that a catarrhal inflammation of the pancreas can be associated with jaundice

and the symptoms of biliary stasis. Investigation of the pancreatic function in such cases agrees very closely with this.

Case.	Sex.	Age, years.	Loewis adrenalin eye test.	Urinary diastase value, units.	Feces.	Cammidge's reaction.	Urine.
1	M.	26	Positive	70	Few muscle fibers; fat ++	Not done	Bile only.
2	M.	22	Negative	3	Fat +; oxalate crystals	Not done	Bile only.
3	M.	34	Positive	50	Muscle fibers +; fat ++	Not done	Bile only.
4	M.	26	Negative	5	Fat +; few muscle fibers; oxalates	Not done	Bile; indican +; diacetic acid.
5	M.	23	Positive	100–200	Fat ++; a few muscle fibers	Positive	Bile; trace of acetone.
6	M.	30	Negative	5–20	Fat ++; a few muscle fibers; oxalates	Negative	Bile; indican; diacetic acid.
7	M.	28	Negative	20	Few muscle fibers; fat +	Negative	Bile only.
8	M.	23	Positive	100	Muscle fibers +; fat ++	Negative	Bile; trace of acetone.

The situation of the common bile duct is of some importance in the question of operative procedure on its terminal portion. The accessibility of the duct is determined to a large extent by its distance from the surface. In approximately one-third of cases the duct is situated on the posterior surface of the gland, so that the approach would have to be by a posterior route.

The question of direct extension of infection from the common bile duct to the pancreas is of some importance in the etiology of pancreatitis, whether acute or chronic. The situation of the duct determines the place of onset, the direction of spread and the extent of damage. This applies to whatever theory of spread is adopted. If infection is brought from the gall bladder directly along the duct, *i. e.,* by infected bile or calculus or growth of bacteria along the mucous surface of the duct, then the importance of the relation of the duct to the pancreas is obvious. On the other hand, following Deaver, if infection is by way of lymphatics, then seeing that these are closely connected with and mainly

follow the course of the common bile duct, the situation of the latter is of some importance.

Another point of interest arises in the case of a tumor of the head of the pancreas. When the common bile duct is situated within the gland then obstructive phenomena arise early in the course of the disease; whilst when the duct is found on the posterior surface these would occur much later on. The prognosis is determined to some extent by this arrangement. In the former type of case cholemia commencing early would tend to shorten the duration of the disease. In the latter variety cholemia would be a late phenomenon and the prognosis would be correspondingly improved.

The relationship of the common bile duct to the pancreatic duct is of the greatest importance in the pathology of the pancreas. Union of the ducts appears to be essential for the production of most forms of pancreatitis, for it is obvious from a study of the statistics that the gall bladder is responsible for the majority of these cases. In approximately 1 case in 5 union does not occur, so that it is difficult to blame the gall bladder, although Deaver's work makes it evident that some, at any rate, of these cases are of lymphatic infection and are thus independent of the anatomical arrangement of the ducts. At the present moment two theories may be said to hold the field, both based on the union of ducts:

1. The theory of Lancereaux, that a gall stone might lodge in the diverticulum of Vater producing complete blockage of the outlet to the duodenum and converting the common bile duct and pancreatic duct into a continuous channel along which infected bile passes, producing destruction and inflammation. The classical case of Opie, in which a small stone impacted in the duodenal orifice of the ampulla of Vater was associated with acute pancreatitis, is the chief evidence for this theory. But such cases are of rare occurrence, so that the theory appears to fit a particular type of case only.

2. The theory of Archibald, which is very similar to the preceding theory except that the blame is placed on the common

duct sphincter. This muscle is said to pass into a spasmodic condition under certain circumstances, *e. g.*, hyperacidity of the duodenal contents, sudden distention of the common bile duct through an abnormal and unexpected rise of pressure in the gall bladder, and this converts the common bile duct and pancreatic duct into a continuous channel. An abnormal rise of pressure in the biliary system can thus force bile, usually infected, along this channel, with pancreatitis resulting.

The action of bile in producing pancreatitis is set on a firm basis by the experimental work of Opie and Flexner. The question of the spread of an inflammatory process from the pancreas to the common bile duct has already been referred to. It must also be remembered that a catarrhal process might spread from the duodenum to the pancreatic duct and common bile duct separately. In that case the symptoms and signs of obstruction of the biliary system would accompany those of catarrhal pancreatitis, quite independently of the position of the common bile duct in respect to the pancreas and the pancreatic duct. The functional value of the accessory pancreatic duct of Santorini is a vexed question ever since Desjardins suggested that infection of the pancreas and biliary passages takes place by this route when there is obstruction of the ampulla of Vater from gall stones. In order that this may occur there must be communications with the duodenum and the main pancreatic duct. In 77 per cent of my cases a direct communication with the duodenum could be determined. Whether this expresses a correct estimate of functional communication cannot be said. Opie found that in 21 per cent of the specimens he examined the duct of Santorini was impervious. In 94 per cent of my cases the accessory duct united with the main pancreatic duct. We are forced to conclude that in at least 30 per cent of cases there is no direct channel from the duodenum through the accessory duct to the main pancreatic duct. It is possible that the theory of Desjardins holds in some cases. Certainly in the 10 per cent of cases where the duct is larger than or as large as the main duct the question of infection by this route may assume some importance.

F. Mobile Pancreas and Hernia

The occurrence of mobility in the pancreas is extremely rare and is associated with undue mobility and a "dropping" of the abdominal viscera. Wandering spleen has been found in association with a movable pancreas. In such a condition the possibility of torsion of the viscus is to be thought of. Lodgment in a hernial sac has been recorded, as in the case of Rose, where an umbilical hernia contained a movable pancreas. Such a hernia would of necessity be very large and would be limited to the upper abdominal types, especially umbilical.

G. Diverticulitis and Its Relationship to the Pancreas

The chief clinical interest of diverticula connected with the pancreas lies in the occurrence of certain pathological changes which have already been touched upon. These are:

1. Inflammation of the Diverticulum. The symptoms and signs would be those of a localized inflammation of the duodenum extending to the pancreas and tending toward a general peritoneal involvement or abscess formation. The condition could hardly be separated from a duodenal ulcer with perforation and abscess formation or a pancreatic abscess. *X*-ray examination, as described by Spriggs, seems to promise a certain means of diagnosis for subacute and chronic cases.

2. Pressure on the Common Bile Duct. As a result of this process biliary stasis in all its varieties would be found. It is difficult to understand how the diverticulum alone could produce symptoms. The presence of food within it would tend to cause a temporary partial obstruction of the duct, disappearing when the food left the diverticulum. This would depend mainly on the nature of the orifice of the sac. In all of the examples which I have seen this has been wide, so that a free communication with the duodenum was present. With disease of the diverticulum, especially chronic inflammation resulting in fibrosis and contraction, the orifice would tend to become stenosed, so that

impaction of food within the cavity might easily occur through inefficient emptying, and obstruction of the neighboring duct would follow. Inflammation of the sac alone might be responsible for obstruction in the case of an acute inflammation from edema and crowding together of cells with abscess formation, in the case of a chronic inflammation from fibrosis and contraction of scar tissue.

3. Pressure on the Common Bile Duct and Pancreatic Duct. Bell's case, in which there was chronic pancreatitis and slight periportal cirrhosis of the liver in association with a diverticulum at the major papilla, has already been described. It is difficult to understand the mechanism of such a case, unless there had been previous pathological changes in the diverticulum itself. The symptoms and signs would be those of chronic pancreatitis, with a tendency toward the sudden onset of biliary stasis from complete obstruction of the common bile duct.

II. Congenital Cystic Disease of the Pancreas

This very rare disease is overshadowed clinically by the various conditions which it is associated with. Thus, in Pye-Smith's case a cyst of the cerebellum was the main feature, numerous small cysts in kidneys and pancreas being also found. In some cases, notably in Richardson's and Shattuck's, a tumor has been the special feature; whilst in others cystic disease of the kidneys dominates the clinical picture. The disease appears to have been found in patients of varying ages, from infancy to old age. There is no record of the efficiency of the pancreas being tested in any of the cases.

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CONSIDERATIONS IN THE DIAGNOSIS OF LESIONS OF THE BILIARY TRACT*

The Mütter Lecture

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Mingled with the realization of the high honor which you have paid me in inviting me to give the Mütter lecture is a certain amount of misgiving at my temerity in speaking before a Philadelphia audience on a subject which deals with the biliary tract, especially in view of the important work which has been done on this subject by Keen, Deaver, Müller, Sweet, Lyon and others of this city. My reason for selecting this subject, however, is that a continuous interest in it extending over a period of several years has convinced me that no other field of medicine can be regarded as more important than this one, both as regards the frequency of the lesions and the need for a better understanding of them. It will be impossible in a single lecture to do more than touch upon certain phases of the subject. I crave your indulgence, therefore, if I dwell upon only those aspects which have particularly interested me.

Cholecystitis is now recognized to constitute the most frequent organic cause of dyspepsia. Blackford and Dwyer[1] found in a series of 1650 patients with gastric symptoms that the approximate relative frequency of abdominal organic disease causing dyspepsia

* Read, December 5, 1924.

was: Gastric ulcer, 1; gastric carcinoma, 2; "reflex" appendicitis, 4; duodenal ulcer, 6; gall-bladder disease, 12. Eusterman[2] from a study made at the Mayo Clinic states that of the patients with gastric symptoms there are 60 per cent more cases associated with a diseased gall-bladder than with a peptic ulcer. Despite its frequency, however, there is no satisfactory explanation of why this association of gastric symptoms with cholecystitis should exist.

An accurate knowledge of the involved pathology and of the pathogenesis of the lesions of the biliary tract is the necessary basis upon which must rest both an accurate diagnosis and a rational treatment. Certain features of the pathology and pathogenesis will, therefore, be discussed because of their important bearing upon what is to follow concerning the diagnosis. Mention will be made first of the prevalent conception that in cholecystitis it is the mucous membrane of the gall-bladder that is chiefly involved. This conception is erroneous in the vast majority of instances, as judged both by the microscopical examination of removed gall-bladders and by an overwhelming weight of experimental evidence. In a large series of gall-bladders, representing all degrees of inflammation, which I have examined, I have never seen the inflammation limited to the mucous membrane; and only in exceptional instances has it been most marked in that portion. On the contrary it involves the whole wall, and usually the evidence of the inflammation is more pronounced in the periphery than in the mucosa. It occasionally happens, however, that gall-bladders which contain foreign bodies such as calculi do show a little more evidence of inflammation in the mucosa. Despite the facts in the case, however, too much stress is still placed upon the mucous membrane both by pathologists and clinicians. It will probably be at least another generation before the expression "catarrhal icterus" is eradicated from our text-books, in spite of the fact that here again there is no substantial evidence that we are dealing with an inflammation of the mucous membranes of the ducts any more than with an inflammation of the whole thickness of their walls, or, to use a better expression, an interstitial cholangitis.

It is only recently also that it has been recognized that, since the gall-bladder anatomically is an integral part of the biliary tract, both intrahepatic as well as extrahepatic, inflammations of that organ are not confined to it but are present practically always throughout the whole biliary system. In 1918 observations were published by the author[3] which, so far as is known, for the first time indicated that a hepatitis is a constant accompaniment of cholecystitis. The inflammation in the liver is chiefly present in the interlobular sheaths and appears to be a pericholangitis. The constancy of this finding has been confirmed by others, for example, Judd[4] and Heyd, Killian and MacNeal.[5] The observation was also made at that time that a late stage of this lesion might be represented by a well-marked biliary cirrhosis, even if there had never been jaundice. The conception, therefore, often expressed, which regarded obstruction and stasis of bile as necessary for the production of biliary cirrhosis was shown to be erroneous.

In later publications we [6, 7] presented evidence which indicated that in many cases, perhaps in a majority, cholecystitis represents a direct extension to the wall of the gall-bladder from a liver already inflamed. The hepatitis usually begins and is most marked in the interlobular, or periportal, tissues; and it is apparently due to infection brought to the liver by the portal vein, and, more rarely perhaps, by the hepatic artery. A pericholangitis then occurs, and because of the intimate anastomosis between the lymphatics of the intrahepatic and extrahepatic biliary systems a direct extension into the wall of the gall-bladder takes place as well as into the common duct and probably also into the pancreas. From the antecedent hepatitis, therefore, a cholecystitis, choledochitis and probably also a pancreatitis can be understood to occur if, in the consideration of inflammation in this locality, we apply the well-known facts concerning inflammation in general, namely, that it extends by way of the lymphatics. The ideas above expressed would explain, more readily than any others heretofore offered, the frequent and well-recognized association of biliary tract infections with lesions of the portal system (appendicitis, peptic ulcer, typhoid fever, suppurating hemorrhoids, etc.).

It was shown also that hepatitis will follow experimentally produced cholecystitis. The possibility of the establishment of a vicious circle between the liver and the gall-bladder is therefore suggested whereby each may reinfect the other. It is not to be inferred from these conclusions that the opinion is held that all cases of cholecystitis are due solely to a lymphatic spread from a hepatitis. Some are doubtless due to hematogenous infections of the gall-bladder as advocated by Rosenow,[8] although here also it is possible that some of his cases of cholecystitis experimentally produced by intravenous injections could be explained on the basis of a lymphatic transmission of the infection to the gall-bladder from the liver. Some cases also of cholecystitis are doubtless due to involvement of the mucosa first and are therefore contact infections. These cases would be especially those in which foreign bodies (calculi) are present or in which an alleged stasis of bile might occur. This point has been rather extensively discussed by Seelig.[9] In view, however, of the extreme difficulty encountered in the experimental production of cholecystitis merely by the introduction of bacteria into the lumen of the gall-bladder and also in view of the fact that in most cases of cholecystitis in the human the inflammation is seen to be most marked at the periphery and less marked in the mucosa, it seems reasonable to conclude that cases due to contact infection of the mucosa must be relatively few in number.

The general features of the lymphatic origin of cholecystitis as briefly stated above have received rather wide acceptance; and I know of no work, either clinical or experimental, which has cast any doubt on the probability of this explanation of the origin of cholecystitis, at least as applied to many cases. After our last article on this subject was prepared, my attention was drawn to an article by George Müller[10] published as early as 1905 in which he made the significant statement: "It is reasonable, therefore, to conclude that infection from the portal vein may reach the gall-bladder through the superficial collecting lymphatics as well as from the bile." It is unfortunate that he regarded this as a rare occurrence and that he did not pursue the idea further.

The idea of attributing the associated chronic pancreatitis to a lymphatic spread from the gall-bladder originated with Deaver and has received much subsequent support, especially in the work of Maugeret[11] as well as apparently in our own. It has been questioned, however, by Archibald,[12] to whose criticisms a reply has been made by Deaver and Sweet.[13] The disagreement is due to a difference of opinion as to whether or not the lymphatics which pass along the common duct actually enter the pancreas. Archibald's contention is that they do not penetrate the pancreas but merely pass along anterior to it.

Diagnosis. The diagnosis of classical cases of biliary pathology by the well-known clinical signs has always been easy, but it is becoming more and more evident that the atypical and the early cases present such vague clinical evidence that many of them will be missed unless other diagnostic resources are made available. In the majority of instances the clinical signs and symptoms are expressions of the late effects of disease. The procedure of Lyon seemed to give promise of affording additional information which would be of diagnostic value. Unfortunately, however, since it dealt at best only with the contents of the gall-bladder, its value could be only inferential, since there is no assurance that either the mucous membrane or the bile is always altered in cases of cholecystitis. Likewise it was based on the assumption that the gall-bladder empties itself through the cystic duct, a point which Sweet[14] has seriously questioned. We believe, however, that evidence which will be presented later this evening will be fairly convincing that the gall-bladder is capable of emptying itself through the cystic duct. But, regardless of this fact, Lyon's test has not been found useful by a number of observers, although it should be stated in fairness to Lyon that many of his critics have misunderstood his method and have not used it correctly. The literature on this subject has been extensively reviewed in a recent article by Jones.[15] Likewise similar disappointment, at least from the standpoint of the diagnosis of cholecystitis, has followed the use of tests of which the principle is based upon a disturbed liver function. In view of the constant association of a hepatitis with

cholecystitis which was mentioned above, it seemed reasonable to hope that perhaps there might be a sufficient disturbance of liver function, even in early cases of cholecystitis, to permit its recognition by functional tests. In discussing this failure Gonzalez and Karr[16] recently have laid emphasis on the "large factor of safety of the liver which precludes the use of any functional test to detect minor disturbances of the organ." Furthermore, at best, any test based on a disturbed liver function would of necessity furnish only indirect evidence in the diagnosis of cholecystitis.

Of all theoretical laboratory possibilities it would seem that the *x*-ray would offer the most hope of providing additional help in the diagnosis of obscure cases of cholecystitis if it were possible to see the gall-bladder by this means, in a manner analogous to the revolutionary effects of the *x*-ray in the diagnosis of lesions of the chest, of the alimentary tract, etc. But here again, in the past, the *x*-ray has been a disappointment for reasons which are well known. What was needed to make the *x*-ray more efficient was a new principle which would be based on the idea of giving the patient some substance which, after getting into the gall-bladder, would permit its visualization. Theoretically, then, cholecystography should become as helpful in diagnosis as pyelography or as the visualization of the stomach by means of the opaque meal.

Cholecystography has now been shown by us to be possible by a variety of substances. It has become a safe clinical procedure of unquestioned effectiveness in the diagnosis of abnormalities of the biliary tract, even in such mild cases of cholecystitis that an accurate diagnosis by any other means would be impossible. Its value lies not only in the ability to recognize gross pathological alterations of the biliary tract but also in the fact that it serves as a rather precise functional test of the gall-bladder. For this purpose the halogenated phenolphthaleins seem at present to be the most useful, and of these the sodium salt of tetraiodophenolphthalein has been found to be the most desirable up to the present time. Investigation of other substances is in progress, and

is it possible that some more desirable compound may be found.

THEORY OF CHOLECYSTOGRAPHY. The theory upon which the procedure is based is that if any substance containing either a metal or atoms of bromine or iodine could reach the gall-bladder in sufficient concentration, then that organ would be made opaque to the roentgen-ray. To be practical, the substance must be one which can be given either by the alimentary canal or by injection. Moreover it must be relatively non-toxic and sufficiently soluble to avoid the necessity of giving large volumes of fluid. In any case, presumably, it would have to be a substance which would be excreted by the liver and carried to the gall-bladder in the bile. Moreover, the ability of the gall-bladder to concentrate its contained bile, as shown by Rous and McMaster,[17] would indicate that a sufficient time must elapse before a shadow of maximal density would occur. Reasoning from these premises the conclusion would have to be drawn that the shadows of sharpest contrast would be obtained in normal individuals. Similarly also, no shadow would be expected to appear if the liver were unable to excrete the substance in sufficient amount, if the cystic duct were occluded, or if the function of the gall-bladder were sufficiently impaired to prevent the concentration of the material. Intermediate degrees of changes from the normal conditions will result in the appearance of shadows which will require for their interpretation a skill which can be obtained only by an extensive experience with the method. All of these conclusions have been found true as our own experience with the procedure has developed. These points will be discussed more elaborately in the section on interpretation.

HISTORY OF DEVELOPMENT. The work of Abel and Rowntree[18] in 1910 on the pharmacological actions of some of the phthaleins and their derivatives showed that many of these were excreted in large part in the bile, and it formed the basis of the extensive use to which some of them have been put as a means of determining the functional capacity of the liver. With this work as a starting point it occurred to us that it might be possible to obtain roentgen-ray shadows of the gall-bladder if substances were used which

would contain a nucleus identical with, or closely allied to, phenolphthalein with which iodine or bromine atoms had been combined. Experiments were begun in the summer of 1923. The first substance which we used was tetraiodophenolphthalein of the following formula:

Both the free acid and the sodium salt were used. By the use of this substance it was demonstrated in dogs that cholecystography is possible by the intravenous injection of a substance which contains a phenolphthalein nucleus. Unfortunately, however, it happened that our first preparation contained toxic impurities which resulted in the death of some of our animals. Thinking that the toxic results were due, in part at least, to inevitable decomposition products of the iodine compound we decided to try the tetrabomine product instead. By analogy with a well-known chemical fact that organic iodine compounds are usually less stable than the corresponding bromine compounds, we concluded that tetrabromphenolphthalein would probably be less toxic than the tetraiodophenolphthalein. It was disappointing, however, to have to abandon temporarily the use of the latter because, theoretically, by virtue of the higher atomic weight of iodine, smaller doses of the tetraiodophenolphthalein should be required to produce good shadows. It was not until the summer of 1924, when we were able to procure some highly purified tetraiodophenolphthalein that we discovered that our former bad results were in large part due evidently to impurities which could be eliminated. This discovery permitted us to use the tetraiodo compound on the human subject with the gratifying result that relatively few toxic results occurred when doses were employed which were only about half so large as those necessary to be used when the tetra-

brom compound was given. In fact we are now using it fearlessly in out-patients who are permitted to go home after their injections. This finding, therefore, agreed with our theoretical premises.

For the reasons stated above, however, much of the early work, including the working out of the criteria of interpretation, has been done with the sodium salt of tetrabromphenolphthalein. The use of the tetraiodo compound does not change in any way the standards of interpretation as worked out for the tetrabrom. Presumably the criteria of interpretation would be the same for any substance which would make the gall-bladder opaque to the roentgen-ray. As will be seen below, we have used many other substances experimentally. A vast number of possibilities exists; and it is therefore entirely possible that in the future some other substance will be found to be preferable to any of those which we have so far used.

The substances which we have used in the development of this work have for the most part been prepared for us by Dr. N. Drake of the Research Department of the Mallinckrodt Chemical Works, St. Louis. They are as follows:

I. Halogenated Derivatives of Phenolphthalein Compounds.
   1. Tetraiodophenolphthalein.
   2. Tetrabromphenolphthalein.
   3. Octabromphenolphthalein.
   4. Dibromphenolphthalein.
   5. Diiodophenolphthalein.
   6. Tetrachlorphenoltetrabromphthalein.

II. Halogenated Derivatives of Phthalein Compounds.
   1. Phenoltetrachlorphthalein.
   2. Phenoltetrabromphthalein.
   3. Phenoltetraiodophthalein.

III. Sulphonated Halogenated Derivatives of Phenolphthalein.
   1. Dibromphenolsulphonephthalein.
   2. Diiodophenolsulphonephthalein.
   3. Tetrabromphenolsulphonephthalein.
   4. Tetraiodophenolsulphonephthalein.

IV. Halogenated Derivatives of Resorcinolphthalein, or Fluorescein.

1. Fluorescein.
2. Tetrabromfluorescein (eosin).
3. Tetraiodofluorescein (erythrosin).
4. Tetrabromdichlorfluorescein (phloxin).
5. Tetraiodotetrachlorfluorescein (rose bengal).
6. Octaiodofluorescein.
7. Dibromoxymercurifluorescein (mercurochrome–220 soluble).

V. Miscellaneous.

1. Tetrabromphthalate.
2. Tribromphenol.
3. Hexamethylene-tetramine iodine compound.
4. Arsphenamine.
5. Carbamide tetrachloriodide.
6. Phenolphthalein.
7. Brilliant vital red.
8. Trypan blue.
9. Methylene blue.
10. Gentian violet.
11. Azorubin.
12. Sodium bromide.
13. Sodium iodide.

Of this number, the salts of ten* have been shown to have the power of making the gall-bladder visible, namely, tetraiodophenolphthalein, tetrabromphenolphthalein, octabromphenolphthalein, phenoltetrabromphthalein, phenoltetraiodophthalein, tetrachlorphenoltetrabromphthalein, tetrabromfluorescein (eosin), tetraiodotetrachlorfluorescein (rose bengal), tetraiodofluorescein and octaiodofluorescein. Some of the last eight, however, have disadvantages which seem to preclude their clinical use.

* In preliminary experiments sodium bromide and sodium iodide have not proven satisfactory, but further work with these substances is in progress. It would seem, however, that they would be less satisfactory than those substances which are more specifically secreted into the bile.

PHARMACOLOGY. In their pharmacological reactions there is no appreciable difference between tetrabromphenolphthalein and tetraiodophenolphthalein. This is to be expected because of their similarity in structure. The clinical superiority of the latter lies in the fact that doses of only about half the size can be given with equally good roentgenological results. This practically eliminates the toxic effects which have been the chief obstacle to a more widespread use of the procedure. Tetrabromphenolphthalein has a molecular weight of 634, and it contains about 50.4 per cent of bromine. In contrast to this, tetraiodophenolphthalein has a molecular weight of 822 and it contains about 61 per cent of iodine. This difference of course is due to the fact that the atomic weight of iodine is 127, while that of bromine is 80; and it is because of this fact that equally good shadows can be obtained with much smaller doses of tetraiodophenolphthalein than of the tetrabrom compound.

The sodium salt of both the tetrabrom and the tetraiodophenolphthalein is a blue crystalline compound which is readily soluble in water. A 50 per cent solution can be obtained by heating. Prolonged exposure of even the dry salt to the air and light causes it to fade and increases its toxicity. It should, therefore, be kept in brown bottles.

Both substances have about the same degree of toxicity, and in toxic doses they both produce the same general symptoms. Dogs tolerate well doses of 0.2 gm. of either substance per kilo of body weight. We have not exceeded in the human, however, doses larger than 0.1 gm. per kilo; and with the tetraiodo compound satisfactory shadows are obtained with doses of 0.055 gm. per kilo. Repeated examinations of small pieces of the liver from both the dog and the human after the administration of doses of this size have failed to reveal any abnormalities. No effect on the clotting time of the blood is observed with standard cholecystographic doses; but if these doses are exceeded, slight hemolysis may occur.

The color of the blood serum and of the bile is unchanged with these substances in contradistinction to the somewhat similar compounds, namely, the phenoltetrabrom and the phenoltetraiodo-

phenolphthalein. For that reason there is no satisfactory colorimetric method for their determination in either the blood serum or the bile. The substances fluoresce and have absorption bands in the spectrum.

Practically the entire bromine content of tetrabromphenolphthalein may be recovered in the bile after injection. The following experiment was performed to determine the amount of bromine excreted: A laparotomy was performed on a 6.4 kilo dog. The common duct was canalized with a small glass tube around the distal end of which was tied a rubber bag for the collection of bile. Another bag was likewise connected with the gall-bladder. The abdomen was closed and the dog was given 1 gm. of sodium tetrabromphenolphthalein intravenously. The animal was killed at the end of forty-eight hours and 112 cc of bile collected from the two bags. The 112 cc of bile contained 0.4569 gm. of bromine. Theoretically 1 gm. of the tetrabrom should contain 0.47 gm. of bromine. Thus, in this experiment 97 per cent of the bromine injected was recovered from the bile in a period of forty-eight hours. In two experiments to determine the amount put out in the bile in twenty-four hours after the injection of 1 gm., the results were 0.25 to 0.34 gm. of bromine respectively, or 53 per cent and 72 per cent respectively.

To determine the concentration of bromine in the bile necessary to produce a shadow the following experiments were performed. To four dogs sodium tetrabromphenolphthalein was given in doses of different amounts, and after twenty-four hours they were killed. Roentgen-ray films showed in each case dense gall-bladder shadows. The bile was collected from each of the gall-bladders and a quantitative analysis for bromine gave the following results:

Dog.	Weight, kg.	Dose, gm.	Bile, cc.	Bromine, gm.	Percentage concentration of bromine in bile.
238	10.0	2.0	11	0.0696	0.63
239	7.0	1.5	16	0.0720	0.45
240	6.0	1.5	6	0.0504	0.83
241	8.4	2.0	19	0.1424	0.75

Excellent shadows therefore may be obtained by concentrations of bromine in the bile varying from 0.45 to 0.83 per cent. These

analyses were made for us by Mr. Shrewsbury under the direction of Prof. P. A. Shaffer of the Department of Biological Chemistry. Certain unexpected difficulties were encountered in making the analyses for iodine in the bile after the injection of tetraiodophenolphthalein. For that reason it is impossible to state in this paper what concentration of iodine in the bile is necessary for the production of good shadows, but the presumption seems reasonable that a much smaller concentration of iodine will be required because of its greater atomic weight.

Injections of both the tetrabrom and the tetraiodophenolphthalein are followed by a perceptibly increased flow of bile. These substances are not efficient biliary antiseptics in the concentrations employed for cholecystography, as evidenced by their effects on cultures of various bacteria.

Fairly rapid intravenous injections of the sodium salt of either substance induces a sharp transient fall of blood-pressure of about 15 mm. of mercury in the dog. A prolonged injection over a period of ten minutes or longer may not be followed by a fall of blood-pressure. We have never seen a rise of blood-pressure to a point above normal after single or multiple injections either experimentally or clinically. A fall of blood-pressure similar to that obtained after injection of the sodium salt of either substance can be obtained by the intravenous administration of an equal amount of phenolphthalein. Clinical cases have had careful blood-pressure readings made at frequent intervals for a considerable time after injection, and in the majority of cases there have been no changes in blood-pressure. In a few there has been a sharp fall. The marked falls of blood-pressure were accompanied by systemic reactions. We have found that in those cases in which there have been falls in blood-pressure accompanied by other symptoms, prompt relief may be afforded in most instances by the administration of 0.5 cc of a 1 to 1000 solution of adrenalin chloride, as first suggested to us by Case.

Both substances are non-irritating when applied to the skin. In any considerable concentration, however, they will produce necrosis when injected into the subcutaneous or muscular tissue. Suspensions of the free acid and of the sodium salt in olive oil and a

solution of the sodium salt in olive oil have been injected subcutaneously and intramuscularly into experimental animals. The gall-bladders of rabbits have been visualized by the roentgen-ray in several instances with each of the preceding methods; but the shadows have been obtained inconsistently. No gall-bladder shadows have been obtained in dogs by either method. Usually the subcutaneous injection was absorbed in forty-eight hours without marked local reaction.

Shadows of the gall-bladder may also be obtained after the administration of the substances by mouth. This method is being investigated at present. It would seem probable, however, that an intravenous injection must necessarily present advantages over the oral administration because, in the interpretation of the cholecystograms, it is necessary to know how much of the substance has reached the liver. The uncertainty of intestinal absorption is present with any substance which is administered by mouth, and this uncertainty must be increased when the particular substance has a slightly laxative action, as is the case with the phenolphthaleins. It is possible, however, that subsequent work will show that oral administration may first be tried, to be followed later by the intravenous administration if any abnormality is found. The intravenous method of administration can then be reserved as a last resort.

Of the other substances listed as having been tried, 8 produced roentgen-ray shadows of the gall-bladder when injected intravenously, but all of the 8 had certain disadvantages as compared with either the tetrabrom or the tetraiodophenolphthalein. The disadvantages consisted chiefly either of a toxicity too great to permit clinical use or of a general staining of the body tissues.

It was hoped that some of the sulphonated compounds which we studied might give rise to shadows of the kidney even if they did not produce cholecystograms, because, by the addition of a sulphone radicle, there is a greater tendency for many organic substances to be excreted through the kidney, as was shown by Abel and Rowntree in the case of the phenolsulphonephthaleins. Unfortunately, however, no kidney shadows were produced.

TECHNIC. In using either the tetraiodo or the tetrabromphenolphthalein it is essential that digestion should not be in progress at the time of injection. Otherwise no shadow may be produced even in a person with a normal gall-bladder. In order to obtain a shadow of maximal intensity it is necessary to have maximal secretion into the bile and maximal concentration of the substance within the gall-bladder. If food is present in the duodenum, our own and accumulated evidence seems to indicate that sufficient bile is poured into the intestine to prevent the maximal entrance or concentration of the dye in the gall-bladder. Accordingly the routine procedure which we now carry out for intravenous use is as follows:

In the case of tetraiodophenolphthalein, 3½ gm. of the sodium salt are dissolved in 28 or 30 cc of freshly distilled water for an individual weighing 125 pounds or more. The solution is filtered through a fine filter paper and sterilized in a boiling water-bath for fifteen minutes. We have put individual doses into ampules and sealed them before sterilization for convenience. Solutions in ampules have been used without any change in toxicity as long as three weeks after preparation. We do not know how long they might be kept safely before use. The solution is given intravenously in two doses, one-half hour apart, in the morning before breakfast, between 7.30 and 9 A.M. Care should be taken not to allow extravasation outside the vein during the injection. Solutions of tetraiodophenolphthalein made in this dilution may produce induration, but in our experience no sloughing of tissue has ever occurred. If the sodium salt of tetrabromphenolphthalein is used, a dose of 4.5 to 5 gm. is dissolved in from 35 to 40 cc of freshly distilled water and injected as described above.

Certain orders for the patient are essential:

1. Breakfast should be omitted.
2. Lunch should be omitted, but the patient may have a glass of milk.
3. Protein should be omitted from the evening meal.
4. Water is allowed *ad libitum*.
5. Alkalinization of the stomach contents by frequent doses of sodium bicarbonate by mouth is helpful.

The rationale of the latter procedure will be explained in an article to appear soon, by Cole,[19] who found experimentally on dogs that the flow of bile into the intestine through relaxation of the sphincter of Oddi is prevented or much diminished by keeping the contents of the stomach alkaline. This action probably tends to promote the concentration of bile in the gall-bladder.

Roentgenograms are taken in series at four, eight, twenty-four and thirty-two hours after injection. The following technic is used in making the cholecystograms: A radiator Coolidge tube is used with duplitized films under double intensifying screens. The smallest practical diaphragm is used, and compression is made with the cone on the patient, who lies on his abdomen on the table. A flash exposure is made, a 60 milliampère current with a 6-inch spark gap being used. The spark gap varies with the thickness of the patient. The Potter-Buckey diaphragm may or may not be used.

When the method of oral administration is used we usually give a dose of 5 gm. of the sodium tetraiodophenolphthalein distributed in 5 enteric capsules (salol coated). These are taken preferably at night, during or soon after the evening meal. The first roentgen film should then be taken the next morning. Breakfast should be omitted, and the dietary instructions are the same as with the intravenous method. If vomiting or diarrhœa should occur, a failure to obtain a shadow may have no significance because enough of the substance may not have been absorbed. Similarly, if the capsules remain undissolved, the same error will result.

Interpretation. If the technic described above has been carried out, a normal gall-bladder will show the following reactions: Usually at about the fourth to the seventh hour after the injection a faint but definite outline of the gall-bladder appears which is seen to have the contour of the normally shaped organ but to be somewhat larger than normal gall-bladders usually seen at laparotomy. At the end of twenty-four hours the shadow is much more distinct but contracted down to only about one-half of its earlier size. From then on until about the forty-eighth hour the shadow diminishes in size and fades gradually.

Abnormalities reveal themselves in various ways. A failure to

obtain any shadow after carefully following the recommended technic has invariably indicated definite pathology of the biliary tract. It is conceivable, however, that in rare instances of very serious disturbance of hepatic function an insufficient amount of the substance might be secreted to produce a shadow even without any appreciable alteration of the gall-bladder, but we have not yet encountered this difficulty. Abnormalities of less degree have shown themselves by such phenomena as late appearance of a shadow, irregular mottling, etc. As experience with the method increases it becomes more and more evident that it is an index of function of the gall-bladder rather than one which shows sharply distinct pathological lesions. For example, two such different pathological conditions as obstruction of the cystic duct and a fibrosed gall-bladder without obstruction of the cystic duct will both usually result in a failure to obtain a shadow. The reason for this lies in the fact that, although in the first instance the substance has not been able to enter the gall-bladder, in the second instance the gall-bladder has not been able to exercise its normal function of concentrating the bile. In earlier work one[20] of us has called attention to the fact that cholecystitis is practically invariably an interstitial inflammation rather than one limited to the mucosa and that this is due very largely to the frequency with which cholecystitis has its origin in a lymphangitis secondary to a hepatitis. As a result of the obliteration of lymphatic vessels in the wall of the gall-bladder by inflammation, the normal ability to concentrate the bile which was demonstrated by Rous and McMaster[21] becomes seriously impaired. The sensitiveness of this method in revealing abnormalities of function of the gall-bladder is one of its most striking assets in the diagnosis of slight degrees of cholecystitis. As our interpretation of cholecystograms has become more nearly perfected we have become more and more impressed with the fact that it is a more accurate method of revealing lesions of the gall-bladder than any other in our possession except that of adequate inspection and palpation at operation with generous exposure. In fact, in several instances we have removed doubtfully normal gall-bladders on the strength of the cholecystographic findings and later we have found them to show

definite signs of inflammation with the microscope. It is because of its sensitiveness to slight functional changes that cholecystography becomes of great value in the diagnosis of the cases of early and comparatively slight cholecystitis which are most difficult to diagnose by any other method, either clinical or laboratory. Heretofore most cases could be accurately diagnosed only after they had gone to the stage of advanced pathology with scarring, formation of stones, etc. In the sense, therefore, that this method presents the possibility of early accurate diagnosis it adds also the possibility of creating another chapter in preventive medicine, for by early treatment most of the ravages of long-standing cholecystitis with its accompanying serious effects on the liver and pancreas can be prevented.

Gall-stones have sometimes been visualized by appearing as "negative shadows" in the cholecystograms. That is, the places occupied by stones appear as areas of less density, doubtless because each stone takes the place of its corresponding volume of dye. More often, however, we have failed to visualize stones which were later proven at operation to be present, because usually a cholecystitis which is severe enough to be accompanied by stones fails to respond by any shadow of the gall-bladder at all. But the method has often proved useful in distinguishing between renal stones and gall-stones. Adhesions have sometimes been recognized by distortions in the outline. Surprising abnormalities of position of the gall-bladder have been recognized; in 1 case, for example, a gall-bladder was found to be in the pelvis.

Results. We have studied 261 individuals by cholecystography, using the intravenous injection of the sodium salt of either tetrabromphenolphthalein or tetraiodophenolphthalein. Of this number it has been possible to verify our roentgenological diagnosis in 80 patients upon whom operations have been performed. In this series our cholecystographic diagnosis has been found correct in 96.25 per cent of cases. In all the cases of operation on the gall-bladder the organ has been removed and subjected to microscopical examination. In the last 20 cases which have come to operation the cholecystographic diagnosis has been confirmed in every one. These diagnoses have been made for the most part

by Dr. Sherwood Moore and his associates of the department of roentgenology. As in all other diagnostic methods, satisfactory skill in the interpretation of results will be acquired only by an extensive experience.

Toxic Actions. The chief deterrent to a more general use of the method of cholecystography in the past has been the toxic reactions which some patients have manifested. These have varied from slight dizziness and nausea in some cases to a condition of temporary collapse with a sharp fall of the blood-pressure in others. By using the sodium salt of tetraiodophenolphthalein in the dosage recommended above, however, these reactions have been practically eliminated, and we are now using the method freely on out-patients who are allowed to go to their homes after the injections. It would be advisable, however, not to inject any elderly patients with low blood-pressures or with bad cardiac conditions. The following table presents a comparison of the effects of intravenous injections of sodium tetrabromphenolphthalein and sodium tetraiodophenolphthalein in a series of 21 patients each:

	Sodium tetrabromphenolphthalein.		Sodium tetraiodophenolphthalein.	
	No. of cases.	Per cent.	No. of cases.	Per cent.
No reaction	13	62	18	86
First degree reactions	4	19	3	14
Second degree reactions	1	4	0	0
Third degree reactions	3	14	0	0

The table shows an absence of second and third degree reactions after injection of sodium tetraiodophenolphthalein. We have listed under first degree reactions patients that suffered either a slight headache, vertigo or nausea lasting from a few seconds to ten minutes. Under second degree reactions we include patients that sustained first degree reactions of slightly increased severity for a period of three or four hours. Third degree reactions include patients that had nausea, vomiting, backache, slight tachycardia and temporary fall of blood-pressure. Invariably the blood-pressure in these cases soon returned to normal. Even the patients suffering the severest reactions showed no evidence or symptoms of it the next day.

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THE SIGNIFICANCE OF THE SYMPATHETIC NERVE SUPPLY OF THE VOLUNTARY MUSCLES*

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A NEW OPERATIVE TREATMENT FOR SPASTIC PARALYSIS*

By N. D. ROYLE
SYDNEY, AUSTRALIA

The Mary Scott Newbold Lecture
Lecture XIV

[Introductory Note.—This valuable lecture was given jointly by Dr. Royle and Dr. Hunter. Both spoke without notes and the lecture was illustrated with numerous lantern slides of charts and diagrams, and the results of Dr. Royle's operations were shown by means of moving-picture films. The lecture was recorded by the College stenographer and a copy afterward sent to each of the speakers for revision. It was not long after this that the sad news of Dr. Hunter's death, in London, reached us; and this was followed by a letter from Prof. G. Elliot Smith, of the University of London, stating that our stenographer's transcript had been found among Dr. Hunter's papers after his death. Professor Smith very kindly edited this manuscript and we have been careful to preserve as nearly as possible the exact language used by Dr. Hunter in his lecture.

In answer to a letter sent to Australia, Dr. Royle wrote to us from Sydney, on February 10, the letter reaching us about five weeks later, explaining his inability to send us a revised copy of his address. On his voyage home he had been taken seriously ill and had been entirely incapacitated for work for three months. "I am sorry to give you this trouble, but both in the case of Dr. Hunter and myself it has been due to misfortune."

We regret that this volume must appear without Dr. Royle's lecture, but under the circumstances it is unavoidable.—The Editor.]

* Read October 25, 1924.

The Significance of the Sympathetic Nerve Supply of the Voluntary Muscles

It is a pleasure to be in this famous institution on the present occasion to discuss from the physiological standpoint the results which Dr. Royle has already given to you.

The fundamental point is this: In 1879 Tchiriew called attention to two kinds of nerve endings in striated muscle, one the well-known motor plates and the other the grapelike terminations. He believed the grapelike terminations were converted into the larger motor end-plates. Tchiriew made a point of great importance that merged the morphological and physiological considerations: The large plates are connected with medullated, whereas the grapelike terminations are connected with nonmedullated fibers.

It has been shown by later experimental work that, corresponding to these different kinds of terminations, there is a difference in origin of the nerve fibers. Ordinary medullated fibers are derived from nerve cells within the spinal cord, but the nonmedullated nerve fibers are derived from ganglionic cells in the sympathetic chain. They are sympathetic in the sense Langley employed the term, as has been proved experimentally by Boeke and Agduhr. Their experiments have established on a sound foundation the fact that the nonmedullated fibers proceeding to striated muscles are derived from the sympathetic. They were able to show that twenty-eight days after section of the somatic nerve all the medullated fibers had disappeared, but the grapelike terminations still persisted. This result was published in the *Proceedings of the Academy of Sciences* in Amsterdam (1917 and 1919). The stellate ganglion was removed by Agduhr, and six days later, in the interosseous muscles of the hand, nonmedullated nerve fibers were found to be breaking down.

Of course it has long been known that sympathetic fibers do go to striated muscle. In Schäfer's *Text-Book of Physiology,* published in 1900, Langley referred to their presence and he showed their independence of bloodvessels. They can be shown to be

distinct from the nerves of the bloodvessels; moreover, the endings of the sympathetic nerves upon muscle fibers have been brought into view. Microscopical examination shows them to be true non-medullated fibers. These are the sympathetic fibers with grape-like endings which are unlike large bundles of medullated fibers that proceed to ordinary motor-end plates. As Dr. Langelaan pointed out, physiological experiment proves that these sympathetic endings subserve a definite purpose. Thus, he showed the removal of the sympathetic system led to the loss of a certain element in tone.

The line of research which has led to the idea of such phenomena began in 1896 when Sherrington described the condition of decerebrate animals. He removed the cerebrum of the monkey and was surprised to find a cataleptoid condition. He said when the spinal animal is tested the reflex is performed and the spinal position is lost. In these animals, placing the limbs in any position, the posture is maintained for ten minutes or more. He described this as a cataleptoid state. If the midbrain is transected, not only in all reflex but also passive movements, the muscles can be shown to maintain the position in which they happen to be placed independently of the length: The muscle was just as capable of maintaining this flexed position when its fibers were considerably lengthened as it could maintain this shortened position when the limb was flexed. He referred to it as a "shortening and lengthening reaction."

The points Dr. Royle has stressed in his address are that these reactions and their attendant phenomena disappear after the sympathetic innervation is removed. In the goat, after removing the part of the sympathetic cord that supplies the left hind limb, the latter when drawn out into a semiextended position would not stay there. If placed in any other position it would fall. The other limb would remain wherever placed passively. Muscle tone did not entirely disappear from the operated limb. The element that maintains posture was gone. The element of contractile tone, however, was present. In decerebrate rigidity we believe that both these elements of tone are usually increased.

That is the reason why the animal tends to go into a caricature of standing and to maintain it for such long periods of time. Then, after relaxation does occur, plastic tone is still present and enables the limb to be maintained in any position. This passive tone disappears after sympathetic denervation, and we wish to confirm the suggestion of Langelaan, who did not test his suggestion on decerebrate animals, that muscle tone has a postural reaction, but that there are two elements of tone, respectively, for imposing and maintaining posture. Contractile tone imposes posture. It acts selectively on various groups of muscles. In quadrupeds it acts upon extensor muscles—the antigravity muscles, as Sherrington calls them. Plastic tone fixes the length of muscle fibers. The conclusion at which we have arrived is that contractile tone is subserved by the ordinary motor endings, whereas plastic tone is subserved by the sympathetic. A photograph in Langelaan's memoir represents a frog in which the sympathetic cord of the right side has been removed; this frog jumped and then fell. The tendency to act upon the flexors and right hind limb still remains. The function of striated muscle is to impose and maintain position: The impulses responsible for its reflex activation arise in the muscles themselves.

Sherrington believes that in all the phenomena of muscles in decerebrate animals, both those of contraction and plasticity, which we are emphasizing tonight, there are two elements that can be segregated from one another in such muscles showing abnormal degree of tone. The actual observations of Sherrington are not in any way at variance with our results. We agree in every respect with Sherrington as to the phenomena produced in muscles when the midbrain is transsected, but we believe the element of plasticity is governed by the sympathetic system.

As to the persistence of posture, in order to investigate in the normal animal, without any injury of the central nervous system, whether, for instance, the sympathetic system plays any part in maintaining the position, I cut the sympathetic supplying fibers of the wings of birds. An active posture is posture due to contractile tissues that prevent disturbing forces, such as gravity,

causing the wing to fall to the ground when the brachial plexus is cut through. The imposing mechanism acts through the motor nerves and the maintaining mechanism through the sympathetic. No damage was inflicted on the brachial plexus itself in this experiment; only the sympathetic was cut. The feathers when ruffled do not return to normal position except after a considerable interval. The bloodvessels by their dilatation afford further corroboration of the fact that the sympathetic was really cut. These criteria were also used to confirm the nature of the operation in the domestic fowl. The effect upon the wing was that its flexed position was not completely maintained. When the wing was lifted into normal position it would slowly fall away, because the easily fatigued contractile fibers had to do the whole of the work without the help of the sympathetically-innervated sustaining fibers. This wing was examined daily for long periods of time. An average of three measurements was recorded daily of the distance of the wing from the median plane on the side operated upon and upon the normal side. There was considerable variation, but the left wing retained its droop for sixty days. After that time, however, it was found that the wings were practically equidistant from the midline. It appeared that the effect of the operation had been eliminated. This, however, proved not to be the case. Other factors had been introduced to compensate for the loss. When the bird was kept steady for a period of about fifteen minutes, eliminating the compensatory factor but evoking fatigue, the wing took the usual position and drooped away from the midline. The tone of skeletal muscle can be modified by other influences, and when we cut these essentially vestibular factors out by keeping the animal at rest the wing drooped.

Another interesting result in birds was that in sea gulls, which in their normal state seem to be so tireless, fatigue was rapidly induced in the operated side after a short flight. After a flight of 100 meters the wing is completely flaccid. So potent a factor is the sympathetic in the prevention of fatigue.

But this relieving function of the sympathetic is not shown only in conditions of fatigue, but is constantly playing a part in all

muscular activity. The wing can be maintained by plastic tone, not only in final positions, but during all the intermediate positions. We think there is a reflex arc subserving this element of tone; that impulses follow into the central nervous system and that this reflex association arc is responsible for the maintenance of posture. It so happens that the reflex arc in the sympathetic is at the level of the first thoracic in the fowl, which is thus the ideal animal for segregating the two effects. So far we have removed the ordinary sympathetic trunk and also removed the sensory limb of what we believe to be a reflex arc. The portion of the reflex arc through the brachial plexus we removed without effect on plastic tone. The motor fibers were removed, but the sympathetic connections, efferent and afferent, were left; as a matter of fact the wing in this experiment retained the flexed position in spite of the loss of voluntary movement; it was able to maintain the typical position because plasticity remained. If the wing were taken in the hand it could be moulded into the approximately normal position and remain in that position.

But the wing could be drawn into another position and maintain it also. It could be drawn down further and remain in this more dependent position. It has no voluntary movement and its reflex activity is diminished, but there is a sympathetic control here maintaining position. This shows that "the shortening and lengthening reactions" are present, just as in the decrebrate animal, and they can maintain posture. We believe, in addition to reflexes (active shortening), as brought about through the ordinary motor nerves, in muscles at the same time a passive process goes on which has for its object the maintenance of position and that this influence is effected by the sympathetic innervation. To prove this point finally, if in a bird showing plastic tone after the somatic nerves have been cut the sympathetic supply was removed the wing fell to the ground. In other words, flaccid paralysis had been produced by two stages: First, by removing the somatic nerves; secondly, by removal of the sympathetic.

This gives an illustration of what we believe to be the nervous connections. It bears out the claim by Sherrington, that tone is

maintained by proprioceptive reflexes. Tone is removed in this way; but we believe that the element of plastic tone is maintained, perhaps, only by the first thoracic segment of the upper limb and first and second lumbar segments of the lower. To get rid of the rigidity, which is due usually to this maintaining mechanism acting excessively, it is necessary to remove these roots. Otherwise the only effect will be upon the actual shortening of contractile fibers reflexly. The operation described by Dr. Royle is a selective operation. It removes an element of tone and leaves the muscle ready for any cerebral control or reflexes. When the sympathetic mechanism is removed, the knee-jerks, instead of having slow relaxation, act more briskly. This is due to the elimination of plastic tone. We believe that the reflex is excited by the actual jerk when the patellar tendon is struck. Plastic tone persists, though the muscle fibers cease to contract. In spastic paralysis the limb tends to stay in the extended position. After the operation the limb falls immediately; relaxation is complete. So, as Dr. Royle points out, the increase of plastic tone is not indicated by hyperexcitability; the muscle fibers tend to become shortened and stay shortened. In some cases of spastic paralysis that is shown to a very abnormal degree—a very important fact that I think explains in part some of the difficulties in this conception.

Now when the morphologists began to accept the idea that the skeletal muscles had a double nerve supply, respectively, from the ordinary motor nerves and sympathetic nerves, they (Boeke and Agduhr) believed this applied to each muscle fiber. The point I want to emphasize is that each individual muscle fiber has either a motor or a sympathetic ending, *but not both.* Apply that to what I have been putting forward from the physiological standpoint. Separate muscle fibers are governed by sympathetic fibers and other separate muscle fibers by somatic nerves. In the January number, 1924, of *The Journal of Anatomy,* there is an article on this. Professor Kulchitsky states, although he did not prove, that the fine muscle fibers do not receive a medullated fiber. In 1902, Perroncito made this observation. Further observation by Lathom, on the goat and bird, has confirmed these

conclusions. In other words, there appeared to be two separate muscle fibers to receive these two different sets of nerves. We are aware that the Dutch school, led by Boeke, believe the contrary. They worked with fine sections stained by the Bielshovsky method: This is very difficult from the point of view of tracing the actual source of nerve fibers. We believe that most observations of this respect can be explained by the fact that nonmedullated collaterals from ordinary medullated nerves sometimes go to the same muscle fibers as the latter. In the fowl it is possible to cut off the brachial plexus and so destroy all the somatic fibers without injuring the sympathetic. By this means degeneration of the somatically innervated muscle fibers can be induced. In the normal wing, the muscle fibers appear uniform as to size. After operation marked change occurs. Atrophied muscle fibers are present, but large groups of fibers are unaffected.

There were three sources of information for demonstrating that each individual fiber does not receive the same ending:

1. The histological evidence of the difference in size of the muscle fibers and the difference in the nature of the nerve endings on the thick and the thin fibers respectively.

2. The different physiological effects—qualitative effects on tone—induced by cutting somatic or sympathetic fibers.

3. The fact that section of somatic or sympathetic nerves affects only particular muscle fibers and not others.

Royle and Hunter claim that the sarcoplasm of each muscle is for fixing position. It is difficult to correlate the facts with this conception. How could each individual fiber have this function? I am aware that many papers have been written with the object of proving it. The two muscles which close the shell of a mollusk, one that closes the shells and the other that keep them shut—a movement muscle and a fixing muscle. Two separate muscles with distinct individual fibers coalesce into a single muscle in the vertebrate; and this composite muscle exercises both the functions, movement and fixation. We believe that this more simple conception clears away what has been a fundamental difficulty in neuromuscular physiology. It needs further confirmation, but it is of great interest from its bearing on the phase of the work presented

here tonight. We believe that in voluntary movement certain fibers have the function of contraction, that this contraction is followed up by smoothly acting plastic activities which tend to impose the positions on the limb and so reduce the amount of cerebrospinal effort necessary to induce position. Hence the sympathetically innervated fibers avert the risk of the rapid onset of fatigue. In spastic paralysis, which is generally agreed now to be a relief phenomenon due to the removal of higher levels of activity controlling lower reflex arcs, the element of duration for fixing position was increased so that the patient cannot get out of his fixed position. He can activate groups of muscles, but the difficulty is to move and overcome the resistance to the performance of movement. Once the patient gets in a new position these shortened fibers (sympathetically innervated) become fixed and it becomes difficult to adopt another position. After the operation the patient can use all the spinal paths that he happens to have without the necessity of having to exhaust the voluntary effort in overcoming fixation by what we believe a separate set of muscle fibers altogether.

DISCUSSION

Dr. William G. Spiller: The paper which has been read by Dr. Hunter has opened a new field in the study and treatment of spastic conditions of a certain type, and is of very great value. As it has been shown that the sympathetic fibers innervate striated muscle fibers, one would expect that destruction of these sympathetic fibers would produce atrophy, and Dr. Royle, who has performed quite a number of these operations, has referred to atrophy in some of them. It is desirable to know the extent and duration of this atrophy. I have several times seen atrophy of one side of the face from pressure of an enlarged thyroid gland upon the cervical sympathetic. The explanation for this is now easy.

Dr. Francis X. Dercum: Like every one here, I have been greatly impressed by what I have heard. It seems at first difficult to correlate the facts with those already in our possession. However, we have reason to believe that the skeletal muscles are innervated by two separate motor structures of the central nervous system; namely, by the motor area of the cortex on the one hand and by the striatum and other motor organs of the paleo-encephalon on the other. The relations of these two sources

of muscle tone to each other are beautifully illustrated by the clinical findings, respectively, in hemiplegia the result of capsular lesion and in paralysis agitans. When the pyramidal tract is cut across, the muscles of the hemiplegic side become spastic because their tone is raised by their now unrestrained innervation from the striatum and its adjuncts. When the striatum—more especially the pallidum and putamen—is diseased, as in paralysis agitans and in the Parkinsonian symptom-group following encephalitis lethargica, the tone of the muscles is likewise raised, but now by the unrestrained innervation from the motor area of the cortex.

In the procedure that has been described this evening, the distal neuron of the sympathetic nervous system—the neuron which lies in the sympathetic ganglion—has been separated from the proximal neuron of the sympathetic which lies in the gray matter of the cord and brain stem. It is extremely probable that a muscle intoning influence is directly transmitted to this intraspinal neuron of the sympathetic from the striatum through the pallidorubrospinal tract. If this be so, the loss of muscle tone resulting from the separation of the distal and proximal neurons of the sympathetic can be readily comprehended.

Dr. A. Bruce Gill: For a number of years I have been very much interested in the treatment of spastic paralysis and have routinely employed the Stoffel operation during the past eleven years. We have undoubtedly, by means of Stoffel's method of selective excision of motor nerves, secured quite satisfactory results, and in some cases the results have even been brilliant. By this procedure spasticity is lessened, tendency to contracture and deformity is relieved and there is some approach to restoration of equilibrium between opposing groups of muscles so that the weaker groups, such as the extensors, have opportunity to function when they have been relieved of the overstrain caused by contraction of their opposing flexors.

I am very much impressed by this exposition by Dr. Hunter and shall be very glad to try his methods of procedure. However, spastic paralysis appears to be a complex of conditions in which the elements of power, cerebral control, spasticity and other conditions are very variable in different cases, so that but few cases are exactly alike. It would seem, therefore, that possibly different methods of treatment may be applicable in different cases, and it would appear to me possible that while brilliant results may be obtained by the Royle operation yet there may be left a place also in certain cases for the Stoffel operation and for other accepted orthopedic procedures.

Dr. J. P. Schaeffer: I have nothing to add, but I should like to ask a question of Dr. Hunter: In the muscle specimens shown on the screen,

in which the somatic motor fibers were cut and marked atrophy was noted in some of the muscle bundles, was there a check-up in the histology; that is, was there a difference in striation? May it be that one is not dealing with a wholly voluntary muscle, but with a mixed muscle. The double innervation to voluntary muscle may, after all, have a different meaning. Comparative histological studies would be interesting in this regard.

Dr. Hunter (closing): I would like to mention, in regard to atrophy, that the operated limb of the patient does increase in size, evidently because the fibers which have been imperfectly acting before, simply because the patient does not use the spastic limb to the same extent that he would a normal limb, are functioning more actively. This would not apply to a patient who has kept his spastic limbs constantly exercised. In the patients we have been discussing, some of them had considerable education, as in the case of the little girl who used the left arm in preference to the right, and usefulness of the limb was increased, enabling her to employ special fibers for shortening. In the case of the upper extremity it must be remembered that all the actual sympathetic fibers are removed, whereas in the case of the lower fibers the rami communicantes of the second, third and fourth lumbar segments are operated on, then the sympathetic trunk is cut through. If there is a difference in the effect of the trophic centers it would be interesting to compare the result in respective atrophy. In regard to the histology of these muscle fibers, we were at once faced with the problem as to whether any difference could be seen in the two sets.

I was struck by Kutchitsky's preparations and by his very faithful diagrammatic representations. It may give a differential result if the fibers are different in some way or other, and consequently we are not certain on that point.

Langelaan did show on a diagram two kinds of elements, one type mixed with the other, in the same muscle fiber, and he tried to correlate the effects of nerve injury with Boeke's conception of histology.

In regard to whether the plastic function is due to the sarcoplasm, I would like to point to the fact that the experimental results we have shown tonight refer not only to cases of rigidity: Cutting the sympathetic evidently deprived the animal's limb of something; there is some essential difference from the normal; there has been no injury to the central nervous system; if rigidity, it is later removed.

I know it is impossible to demonstrate all sides of the case. I know there is a considerable body of opinion that the effect of sympathetic innervation is upon all the activity of the muscle. A recent paper, by Orbeli, claims this on the following grounds: That in taking a muscle and stimu-

lating its motor nerves, so that tetanus could not be produced, individual contractures could be produced; and when the sympathetic mechanism was stimulated, then contractions could be again superimposed upon one another, then tetanus was produced. We think the sympathetic influence would be to produce a plastic tremor in the muscle fibers, giving rise eventually to tetanus.

This comes back to Guetzner's contention that there is an intrinsic support which is for this purpose, of helping involuntary activity. Really we are going back to the very old view, and Guetzner said there are higher fibers and lower fibers. We believe that the fibers which carry on their work are perfectly normal, with the ordinary normal impulses passing through the medullated nerves, but the tendency to fixation is thrown out of action. Then, again, comes the question of central connections. I shall not discuss the subject this evening, partly on account of the intricacy of the task of building up from the conceptions we have already given, further conceptions as to the connections in the central nervous system.

The classification of terms we have given tonight depends upon two sets of nerve fibers, efferent in character. The primary subdivision of phenomena of muscle according to which function results from motor and which from the sympathetic. Some impulses, no matter what their source, are going through the sympathetic. We believe the impulses through the efferent somatic nerves give rise to shortening. Impulses from the sympathetic fibers merely fix the length of the fibers and do not excite contraction. Oliver and Schäfer state adrenalin did not shorten. We see again the plastic effect of adrenalin and the prolonged contraction. Bayliss' experiment illustrated that sympathetic fibers were responsible for fixation. We believe that there is this essential difference.

We are faced with a new fact, a new physiological result. We have to face the new fact that there is a double nerve supply instead of a single set. Might not practically all central nervous organs—both sympathetic and somatic—such as the corpus striatum, send down impulses to excite either contraction or rigid plastic tone? I have been able to confirm that in birds by removing the corpus striatum, which can be enucleated without disturbing the cerebral cortex or corticomesencephalic tracts. In such birds we get rigidity. The sea gull always flies to the side on which the corpus striatum has been removed. We believe that the pathways merge through the sympathetic system. We do not deny that impulses also flow down through the ordinary motor pathways, but want to emphasize that the conception we are following up is that the corpus striatum has a dual control over both kinds of muscle fibers. The globus pallidus is for the purpose of regulating the functions of the fixing muscles. That would explain why in plastic paralysis rigidity is the predominant factor.

ANNUAL REPORT OF THE LIBRARY COMMITTEE FOR 1924

Mr. President: In accordance with the ordinances and By-Laws of the College, I herewith submit the following report of the Library Committee for the year 1924:

Total number of volumes in the Library, including the bound volumes and 21,333 unbound "Reports" and "Transactions"	144,421
Number of unbound "Theses" and "Dissertations" .	21,760
Number of unbound pamphlets	145,691

Included in the above are 4,214 volumes known as "Reserves," consisting of second copies of some of the more important periodical publications; also 2,874 volumes more or less incomplete.

The duplicates,* which number 11,910 at this date, are not included in the above total.

The following table shows the number of volumes in the various divisions of the Library:

	Bound.	Incomplete and unbound.	Total.
General Library	102,325	2,827	105,152
Lewis Library	13,770	44	13,814
On permanent deposit:			
S. D. Gross Library . .	3,713	3	3,716
Library of the Obstrical Society of Philadelphia	217	0	217
Mütter Museum† . . .	189	0	189
			123,088

* Shortly after this Report was completed the entire collection of duplicates was disposed of to the Medical School, Otago University, New Zealand; through the courtesy of Sir Henry Lindo Ferguson, F.R.C.S.I.

† The books of the Mütter Museum are not permitted to be removed from the College building.

Received during the year from all sources, 4,234 volumes, 7,489 pamphlets and 10,371 numbers of various periodicals.

Divided as follows:

	Volumes.	Pamphlets.	Journals
General Library	3,813	7,372	10,371
Lewis Library	14		
S. D. Gross Library	10		
By purchase, General Account	124		
In exchange	273	117	
	4,234	7,489	10,371

Accessions (including 30 volumes of "Reserves"): 3,199.

	Volumes.
General Library	3,175
Lewis Library	14
S. D. Gross Library	10
	3,199

Total increase in the number of volumes for the year, 3,199.

Photographs received in response to requests sent out during the past year and voluntary gifts: Fellows, 5. For the War Album (Fellows of the College), 2. Other than Fellows, 92.

Total number of portraits listed, 11,141.

The individual "Donors" for the year ending November 1, 1924, number 416; this represents 985 distinct presentations. Each gift is duly acknowledged and properly recorded.

The following list shows individual gifts of more than 25 volumes, and the number of volumes presented by the various publishing houses:

	Volumes.
Dr. Henry M. Fisher	209
Dr. B. Franklin Stahl	129
Mrs. R. M. Bolenius	121
Dr. Barton Cooke Hirst	74
Dr. George B. Wood	61
Dr. Astley P. C. Ashhurst	57
Dr. Burton Chance	35
The Children's Hospital	33
Dr. Francis X. Dercum	29

From the publishing houses of:

P. Blakiston's Son & Co.	19
F. A. Davis Company	30
Lea & Febiger	34
J. B. Lippincott Company	23
W. B. Saunders Company	70

The Library is indebted for large gifts of pamphlets and unbound periodicals to the following donors:

Dr. Astley P. C. Ashhurst
Dr. Charles W. Burr
Dr. Burton Chance
Dr. Edward P. Davis
Dr. Warren B. Davis
Dr. Theodore A. Erck
Dr. A. A. Eshner
Dr. Clifford B. Farr
Dr. Thomas H. Fenton
Dr. Lawrence F. Flick
Dr. J. C. Gittings
Dr. J. P. Crozer Griffith
Dr. Hobart A. Hare
Dr. Barton Cooke Hirst
Mr. Paul B. Hoeber
Dr. W. W. Keen
Dr. Edward Martin
Dr. George M. Marshall
Dr. Charles K. Mills
Dr. George W. Norris
Dr. David Riesman
Dr. George E. de Schweinitz
United States Department of the Interior
United States Public Health Service
S. S. White Dental Mfg. Company

872 new publications were added to the Library during the past year, viz: United States, 310; Great Britain and Colonies, 261; France, 115; Germany, 164; Italy, 5; all other countries, 17. Of these new publications, 30 were written or edited by Fellows of the College.

13 volumes were presented by the following authors or editors:

Dr. Israel Bram
Dr. Keizo Dohi
Dr. John C. Heisler
Dr. Edward P. Heller
Dr. Jean Monard
Dr. Orlando H. Petty
Dr. William C. Posey
Dr. William A. Pusey
Dr. Robert H. Russell
Dr. Edward A. Schumann
Dr. Linsly R. Williams

5 volumes were sent by the publishers at the request of the following authors or editors:

Dr. Francis X. Dercum
Dr. Herbert Fox
Dr. Milton J. Greenman
Dr. Newton M. Shaffer
Dr. Ross Hall Skillern

Summary of the "Funds":

	Volumes purchased.	Cost.
Henrietta Rush Fales Baker Fund	95	$534.96
Luther S. Bent Fund	39	230.60
William T. Carter Fund	50	209.14
Gerardus Clarkson Fund	36	201.87
Francis X. Dercum Fund	100	279.24
Louis A. Duhring Fund	53	423.01
John D. Griscom Fund	135	423.54
William F. Jenks Fund	113	615.89
Oliver A. Judson Fund	17	78.84
William V. and John M. Keating Fund	30	109.88
William W. Keen Fund	103	512.62
Library Endowment Fund	218	793.78
Horace Magee Memorial Fund	205	1,430.03
J. Ewing Mears Fund	69	537.18
Charles K. Mills Fund	6	14.95
Weir Mitchell Fund	163	307.13
E. E. Montgomery Fund	4	15.50
John H. Musser Fund	16	38.41
Elizabeth K. Newcomet Fund	20	56.42
William F. Norris Fund	37	243.19
Charles A. Oliver Fund	16	84.87
Philadelphia Medical Society Fund	7	104.68
Lewis Rodman Fund	85	550.13
Douglas Stockton Warren Fund	84	400.53
John F. Weightman Fund	41	223.18
Caspar Wistar Fund	94	441.79
	1,836	$8,861.36

Special accounts:

Fund for completing files of journals	458	$1,390.58
Fund for rare and valuable books	54	1,615.84
S. D. Gross Library Account	2	86.11
	514	$3,092.53

	Expended.
Catalogue Endowment Fund—On account of salaries	$37.50
Louis A. Duhring Fund—General purposes of the Library	9,016.44
Morris Longstreth Library Fund—On account of salaries	940.23
George B. Wood Fund—Library supplies, stationery, etc.	359.85

Number of volumes bound, 1,061.

Use of the Library: Visitors, 5,273; Fellows, 2,153; total, 7,426.

The Library has been kept open two evenings each week and on the six minor legal holidays for the same hours and period of time as during the past year:

Evenings.	Visitors.	Fellows.	Total.
78	652	218	870

Legal holidays.	Visitors.	Fellows.	Total.
6	58	30	88

These figures are included in the total given for the year.

	1924.	1923.	Decrease.
Number of books consulted in the Library	13,521	26,675	13,154

The number of books reported as "consulted in the Library" includes only those supplied on demand. Readers have access to the bound volumes of periodicals and works of reference kept on the shelves in the Reading Room, and the Fellows of the College have access to the Book Stacks. There are, therefore, a large number of volumes consulted of which no accurate record can be kept.

	1924.	1923.	Increase.
Number of books taken out	4,313	3,204	1,109

Use of Study Rooms: Average number of rooms in use throughout the year, 5. Greatest number in use at one time, 7. Daily average of the number of volumes in use in these rooms, 125.

Cataloguing: Works, 1,515; volumes, 1,585; cards written, 6,148; printed cards revised, 3,444.

All books added to the shelves during the past year and 158 of the more important pamphlets have been catalogued and shelf-listed; and all bound volumes, including periodicals, transactions and reports, have been accessioned.

Revision of the Catalogue: 6,094 cards have been revised, rewritten and filed.

4,094 unbound pamphlets and reprints have been subject-headed and arranged alphabetically by subject and by author under the subject. No pamphlets have as yet been bound.

We have listed November 1, 1924, 1,183 current periodical publications, including "Transactions" and "Reports," obtained through the following sources:

	American.	Foreign.
Endowment Funds	95	447
By purchase from General Account	20	120
In exchange	52	94
Editors	95	12
Publishers	30	5
In addition, current numbers of periodicals have been received, at stated intervals, through the courtesy of the Editor of the *Therapeutic Gazette*	27	38
	319	716
Reports, not included in the above	135	13
	454	729

The actual number of periodicals received during the year, including new subscriptions (11 foreign) total 1,035. This is an increase of 94 over the previous year. We are still carrying our

lists intact, and changes are made only when official notification is received from our agents, or from the editors or publishers of the journals direct.

The following is a list of the foreign schools of medicine with which we exchanged publications prior to the late war:

University of	Amsterdam	University of	Königsberg
"	Basel	"	Lausanne
"	Berlin	"	Leiden
"	Bern	"	Leipzig
"	Bonn	"	Liège
"	Breslau	"	Lund
"	Erlangen	"	Marburg
"	Geneva	"	Rostock
"	Giessen	"	Strassburg
"	Göttingen	"	Upsala
"	Greifswald	"	Utrecht
"	Halle	"	Würzburg
"	Heidelberg	"	Zurich

Faculty of Medicine of Bruxelles
" " Paris
" " Toulouse
" " Yucatan

It is interesting and very satisfactory to note that since the Armistice in 1918 we have received dissertations and theses from every school mentioned on the above list with the exception of Erlangen, Greifswald, Zurich, Bruxelles and Yucatan. Further it must be understood that at no time, in any one year, were dissertations and theses received from all the institutions mentioned in the list; which is accounted for from the manner in which they are printed and issued. It is quite possible in regard to Erlangen, Greifswald, Zurich and Bruxelles that conditions since the war are such that candidates for the degree of Doctor of Medicine are not required to have their inaugural dissertation or thesis printed. In regard to Yucatan it can merely be stated that no acknowledgments have been received from this institution for a number of years. After further correspondence, if no satisfac-

tory answers are received, it is probable that the names mentioned will be stricken from the exchange list.

During the past year we have heard from Amsterdam, Berlin, Bern, Geneva, Giessen, Göttingen, Halle, Kiel, Königsberg, Lausanne, Leiden, Leipzig, Marburg, Paris, Upsala and Utrecht. 1,419 dissertations and 133 theses have been added to our collection.

We have received in cash from the sale of duplicates for the current year ending November 1, 1924: $198.84

During the past year we have distributed books and journals, on exchange account, to the following:

Boston Medical Library
Library, Rochester Academy of Medicine
Medical Library Association, Baltimore.
Medical Society of the County of Kings, Brooklyn

And have received exchanges from:

Boston Medical Library
College of Physicians, Columbia University
Library, Rochester Academy of Medicine
Medical Library Association, Baltimore

With the aid received from exchanges and purchases made with funds appropriated for the purpose by the Library Committee, we have been able during the past year to complete the files of the following journals:

Allgemeine medizinische Annalen des neunzehnten Jahrhunderts, Leipzig
Archiv für Kriminal-Anthropologie und Kriminalistik, Leipzig
Archiv für pathologische Anatomie und Physiologie und für klinische Medizin (Virchow), Berlin
Archiv für Protistenkunde, Jena
Archives internationales de physiologie, Paris
Berliner klinische Wochenschrift, Berlin
Bulletin de la Société de pathologie exotique, Paris
Centralorgan für die gesamte Chirurgie und ihre Grenzgebiete, Berlin.

Deutsche Vierteljahrsschrift für öffentliche Gesundheitspflege, Braunschweig
Folia Microbiologica, Delft (Holland)
Der Frauenarzt, Leipzig
Jahrbuch der Radioaktivität und Elektronik, Leipzig
Jahrbücher der hamburgischen Staatskrankenanstalten, Hamburg
Jahresbericht über die Fortschritte und Leistungen auf dem Gebiete der Hygiene, Braunschweig
Janus, Leiden
Journal des Connaissances Medico-Chirurgicales, Paris
Journal für Psychologie und Neurologie, Leipzig
Der Kinder-Arzt, Leipzig
Medicinisches Journal, Göttingen
Medizinische Neuigkeiten für praktische Aerzte, Erlangen
Monatsberichte für Urologie, Berlin
Revue générale de clinique et de thérapeutique (Journal des praticiens), Paris
Die Therapie der Gegenwart, Berlin
Travaux du laboratoire de physiologie de l'université de Genève, Genève
Verhandlungen der anatomischer Gesellschaft, Jena
Year Book of the American Pharmaceutical Association, Chicago
Zeitschrift für ärztliche Fortbildung, Jena
Zeitschrift für Fleisch und Milch-hygiene, Berlin
Zeitschrift für Morphologie und Anthropologie, Stuttgart

Amount of fines collected for the current year ending November 1, 1924: $78.40.

List of rare medical books and works of special interest received during the year (it may be well to repeat what was stated in a previous Report that these rare books, what may be termed medical classics, have been acquired for the Library without in any way interfering with the purchase of current medical publications):

Incunabula

(Total number of incunabula at this date, 364 Titles, 348 Volumes.)

Aquino, Thomas de. Super Aristotelis libros de generatione et corruptione.*** Venetiis, Octavianus Scotus Modoetiensis per Bonetum Locatellum, Presbyter, Bergomensis, 1498. [Hain 1535.]
[*Manuscript notes.*]

Fund for Rare Books.

Ficinus Florentinus, Marsilius. Consiglio contro la pestilenzia.*** Florentiae, Monasterium S. Jacobi de Ripoli, 1481. [Hain 7082.]

[*With manuscript notes and full page of contemporary remedies for the plague.*]

Very rare editio princeps from an interesting press at which Dominican nuns are said to have worked as compositors.

Fine large copy in old half morocco with interesting provenance—from the famous library of Count Boutourlin, with book-plate, and book label of Ch. Fairfax Murray.

Luther S. Bent Fund.

Gerson, Johannes Cancellar. Paris. Opera. 3 Volumes. Basileae, Nicolaus Kessler, 1489. [Hain 7624.]

Fund for Rare Books.

Politianus, Angelus. Miscellanea. Florentiae, Antonius Bartholomaei Miscominus, 1489. [Hain 13221.]

[*Our copy lacks ff.* 93–94, "*Emendationes,*" *mentioned by Hain.*]

[*Covers and fly-leaves made from ancient ecclesiastic rubricated and illuminated vellum manuscripts.*]

[*Numerous quotations in Greek type.*]

Fund for Rare Books.

Salernum, School of. [Regimen sanitatis Salernitanum.] Le regime tres utile et tres proufitable pour conserver la sante du corps humain. [Lugduni, Jean Dupre, circa 1490.] [Copinger II, 659.]

[*F.* 120 *blank.*]

Excessively rare first and only recorded edition in French printed during the 15*th century.*

Fund for Rare Books.

Works of Special Interest

Actuarius, Joannes. De urinis libri vii, Ambrosio Leone Nolano interprete; in quibus omnia quae de urinis dici possunt, doctissime tractata continentur Antonii Thylesii Cosentini de coloribus liber.***] Basileae, apud haeredes Andreae Cratandrii [1563].

William T. Carter Fund.

Aëtius, Amidenus. Medici Graeci contractae ex veteribus medicinae tetrabiblos, hoc est, quaternio, sive libri universales quatuor, singuli quatuor sermones complectentes, ut sint in summa quatuor sermonum quaterniones, id est, sermones sedecim, per Ianum Cornarium medicum physicum latinè conscripti. Lvgdvni, Beringer, 1549.

Lewis Rodman Fund.

Aiken, C[harles] R[ochemont]. A concise view of all the most important facts which have hitherto appeared concerning the cow-pox. 2 Ed. London, Phillips, 1801.

Henrietta Rush Fales Baker Fund.

Alliés. Traité des maladies de l'urèthre. Contenant l'origine, les progrès, la guérison radicale des carnosités, callosités, rétentions d'urine et la composition des bougies de toutes espèces. Paris, Desprez, 1755.

J. Ewing Mears Fund.

Anderson, John. Medical remarks on natural, spontaneous and artificial evacuation. 3 Ed. London, Murray, 1796.

Presented by The Pennsylvania Hospital.

Arnaud [de Ronsil] Georges. Anatomisch-chirurgische Abhandlung über die Hermaphroditen.*** Strassburg, König, 1777.

In Exchange.

Aubin. Cheats and illusions of Romish priests and exorcists; discover'd in the history of the devils of Loudun: being an account of the pretended possession of the Ursuline nuns, and of the condemnation and punishment of Urban Grandier a parson of the same town. London, Turner, 1703.

Horace Magee Memorial Fund.

Barra, McPierre. L'abus de l'antimoine et de la saignée; demonstré par la doctrine d'Hippocrate. Lyon, Fourmy, 1664.

Fund for Rare Books.

Basadona, Joannes. [Dyalogi.] Venetiis, Tacuini, 1518.

Francis X. Dercum Fund.

Bayfield, Robert. Tractatus de tumoribus praeter naturam; or, A treatise of preternatural tumors; divided into four sections, and adorned with many choice and rare observations. London, Tomlins, 1662.

William F. Jenks Fund.

Bayle, Fr[ançois]. Problemata physica et medica; in quibus varii veterum et recentiorum errores deteguntur.*** Tolosae, Guillemette, 1677.

Douglas Stockton Warren Memorial Fund.

Bell, Benjamin. Treatise on the theory and management of ulcers, with a dissertation on white swellings of the joints.*** 2 Ed. Edinburgh, Cadell, 1779.

Presented by Miss Margaret G. O'Hara.

Bichat [Marie François] Xav[ier]. Traité des membranes en général et de diverses membranes en particulier. Paris, Richard, an VIII [1799–1800].

Lewis Rodman Fund.

de Bordeu, Théophile. Recherches sur le tissu muqueux, ou l'organe cellulaire, et sur quelques maladies de la poitrine. Nouv. Ed. Paris, Bastian, 1791.

John D. Griscom Fund.

Bosellus, Franciscus. Amaltheum medico-historicum, tres in apparatus digestum, doctrinae varietate, cum omnibus historicis & politicis.*** Patavii, apud Heredes Pavli Frambotti, 1668.

Fund for Rare Books.

Brant, Sebastian. Stultifera navis mortalium, in qua fatui affectus, mores, conatus atque studia quibus *** Germanicis rythmis conscriptus, per Jacobus Locher.*** Basileae, Maiest, 1572.

Horace Magee Memorial Fund.

Brunfels, Ot[ho]. Catalogus illustrium medicorum, sive de primis medicinae scriptoribus. Argentorati, apud Ioannem Schottũ, 1530.
Engraved title-page.

Lewis Rodman Fund.

Cant, Arent. Impetus primi anatomici ex lustratis cadaveribus nati, quos propriâ consignavit manu. Lugduni, apud Petrum Vander Aa, 1721.

J. Ewing Mears Fund.

Cardanus, Hieronymus. Ars curandi parva.*** 2 Volumes in 1. Basileae, Petrina [1561].

Horace Magee Memorial Fund.

Carminati, Bassiano. Richerche sulla natura e sugli usi del suco gastrico in medicina, e in chirurgia. Milano, Imp. mon. di s. Ambrogio Maggiore, 1785.

Caspar Wistar Fund.

[Chicoyneau, François et Senac, J.] Traité des causes, des accidens, et de la cure de la peste. Paris, Pierre Jean Mariette, 1744.

Lewis Rodman Fund.

Chymical, medicinal, and chyrurgical addresses made to Samuel Hartlib, esquire. London, Dawson, 1655.

Henrietta Rush Fales Baker Fund.

Columbus, Christopher. Epistola de insulis nouiter repertis; photolithograph of an edition printed in Paris, about 1493, of the Latin translation of letter of Sanxis, from Archbishop Laud's copy preserved in the Bodleian Library, Oxford, issued with an introductory note by E. W. B. Nicholson. 2 Ed. London, Quaritch, 1893.

"This is a facsimile of which the original exists in only two known copies, both in the Bodleian. I got the last two copies of the facsimile that the Bodleian had for sale."

Presented by E. B. Krumbhaar, M.D.

Combalusier, François de Paule. Observations et réflexions sur la colique de poitou ou des peintres.*** Paris, de Bure, 1761.

Gerardus Clarkson Fund.

Crawford, John. Cases of impotency and virginity fully discuss'd. Being the genuine proceedings, in the arches-court of Canterbury, between the honourable Catherine Elizabeth Weld, alias Aston, and her husband.*** London, Gammon, 1732.

William F. Jenks Fund.

Dalecampius, Jacobus. Histoire generale des plantes, contenant XVIII. libres egalement departis en deux tomes *** faite françoise par Iean Desmoulins. Dernier Edition. 2 Volumes. Lyon, Borde, 1653.

Fund for Rare Books.

Dryander, Joh. Artzenei Spiegel Gemeyner Inhalt derselbigen wes bede einem Leib unnd Wundtartzt in der Theoric Practic unnd Chirurgei zusteht.*** Franckfurt, a. M., Egenolph, 1547.

Fine large copy in modern boards covered with vellum sheet from a printed service-book. Manuscript index.

Gerardus Clarkson Fund.

Du Choul, Guillaume. Discorso sopra la castramentatione, et disciplina militare de Romani, con i Bagni et essercitij antichi de Greci et Romani. Et tradotto in Toscano da Gabriel Simeoni, Fiorentino. Lione, appresso Gvglielmo Rovillio, 1571.

Douglas Stockton Warren Memorial Fund.

Falcon, Jean. Les notables declaratifz sur les Guidon. Lyons, Constantin Fradin, 1515.

Extremely rare first edition.

Fund for Rare Books.

Falconet, Noel. Systême des fievres et des crises, selon la doctrine d'Hippocrate, des febrifuges, des vapeurs, de la goute, de la peste.*** Paris, Coustelier, 1723.

Luther S. Bent Fund.

Fialetti, Odoardo. Il uero modo et ordine per dissengnar tutte le parti et membra del corpo humano. Venetia, Sadeler, 1608.

Fund for Rare Books.

Fienus, Joannes. De flatibus humanum corpus molestantibus commentarius novus ac singularis.*** 3 Ed. Amstelodami, apud Joannem Janssonium, 1643.

William T. Carter Fund.

Fuchs, Leonard. Operum tomus primus; medicamentorum omnium componendi, miscendique rationem ac modum, libris quatuor.*** Francofurti ad Moenum, Lechler, 1566.

Caspar Wistar Fund.

[Galleti, Ant.] Les oeuvres medecinales de l'herboriste d'attigna, contenan les remedes choisis. 3 Volumes in 1. Lyon, Thioly, 1695.

Fund for Rare Books.

Gonzaga, Marco. Cause et rimedii della peste, et d'altre infermita.*** Nuoua. tradotto in Toscano. Firenze, Giunti, 1577.

Fund for Rare Books.

Good, John Mason. Dissertation on diseases of prisons and poor-houses, published at the request of the medical society of London.*** London, Dilly, 1795.

Presented by the Pennsylvania Hospital.

Guarinonius, Hippolytus. Pestilentz Guardien, fuer allerey Stands Personen, mit Säuberung der inficierten Haeuser.*** Ingolstadt, Angemayer, 1612.

Fund for Rare Books.

Guérin. Dissertation sur les maladies de l'urètre, avec des réflexions sur la méthode qu'ont employée jusqu'à présent quelques praticiens. Paris, l'Auteur, 1780.

William F. Jenks Fund.

Hamilton, R[obert]. Remarks on the means of obviating the fatal effects of the bite of a mad dog, or other rabid animal, with observations on the method of cure when hydrophobia occurs.*** Ipswich, Shave, 1785.

Presented by the Pennsylvania Hospital.

Harvey, William. Anatomical exercises concerning the motion of the heart and blood. With a preface of Zachariah Wood, to which is added James De Back, his discourse of the heart.*** London, Leach, 1653.

Fund for Rare Books.

Hoadly, Benj[amin]. Three lectures on the organs of respiration, to which is added an appendix, containing remarks on some experiments of Houston's.*** London, Wilkins, 1740.

(Gulstonian lecture.)

Fund for Rare Books.

Hofmann, Casp[ar]. De usu lienis, cerebri et de ichoribus. Lugd. Batav., Heger, 1639.

Engraved title-page.

Francis X. Dercum Fund.

Howard, John. Treatise on the medical properties of mercury. London, Longman, 1782.

Presented by the Pennsylvania Hospital.

Jenty, Charles Nicholas. Course of anatomico-physiological lectures on the human structure and animal oeconomy.*** 2 Volumes: London, Rivington, 1757.

Presented by Mrs. J. William White.

Laetus, Joh. Ciarla tanaria medicorum. Oder Marcktschreyerey gelehrten Aerzte mit Fleiss in verstandlich Teutsch gesezt. Freysingen, auf Kosten guter Freunde, 1717.

Fund for Rare Books.

Lakin, Dan[iel]. Miraculous cure of the Prusian swallow-knife; being dissected out of his stomach by the physicians of Regimonto, the chief city of Prusia.*** London, Okes, 1642.

Very rare first English edition.

Horace Magee Memorial Fund.

Lavater, Ludov[icus]. De spectris, lemuribus et magnis.*** 4 Ed. Lugd. Batav., apud Iordanum Luchtmans, 1687.

Francis X. Dercum Fund.

Lind, James. Essay on the most effectual means of preserving the health of seamen in the Royal Navy. And a dissertation on fevers and infections.*** New edition. London, Murray, 1779.

Presented by Miss Margaret G. O'Hara.

de Malon. Le conservateur du sang humain, ou la saignée démonstrée toujours pernicieuse et souvent mortelle. Paris, Boudet, 1766.

Henrietta Rush Fales Baker Fund.

Malphighi, Marcello et Fracassatus, C. Epistolae anatomicae. Amstelodami, apud Casparum Commelinum, Anno 1669.

Fund for Rare Books.

Masiero, Filippo. La chirurgia compendiata, ouero instruzioni per il chirurgio in prattica.*** 4 Ed. Venetia, presso Steffano Curti, 1702.

Engraved title-page.

William W. Keen Fund.

Massaria, Alexander. De abusu medicamentorum vesicantium disputatio secunda apologetica ad librum Herculis Saxoniae De phoenigmis. Vicetiae, apud Georgium Graecum, 1593.

Fund for Rare Books.

La médecine et la chirurgie des pauvres.*** Paris, Le Conte, 1740.

William W. Keen Fund.

Mercati, Michele. Instruttione sopra la peste.*** Roma, Accolto, 1576.

Horace Magee Memorial Fund.

Mohrenheim, Joseph [Jacob]. Abhandlung über die Entbindungskunst. Verfasst auf höchstem Befehl Ihro Majestät der Kayserinn aller Reussen, etc. Zum Nutzen ihres Reichs. St. Petersburg, k. Akad. d. Wissenschaften, 1791.

William F. Jenks Fund.

Moncrief, John. The poor man's physician; or, The receipts of the famous John Moncrief of Tippermalloch.*** 2 Ed. Edinburgh, Stewart, 1716.

Horace Magee Memorial Fund.

Monro, Alexander. Traité d'ostéologie. Trad. de l'anglois par J. J. Sue. Paris, Cavelier, 1759.

Presented by William J. Taylor, M.D.

Perkins, William Lee. An essay for a nosological and comparative view of the cynanche maligna, or putrid sore throat; and the scarlatina anginosa, or scarlet fever with angina. 2 Ed. London, Walter, 1790.

Presented by the Pennsylvania Hospital.

Pharmacopoea Persica ex idiomate Persico in Latinum conversa.*** Lutetiae Parisiorum, Michallet, 1681.

Fund for Rare Books.

Pinel, Philippe. Traité médico-philosophique sur l'aliénation mentale, ou la manie. Paris, Richard, an IX [1801].

Presented by Francis X. Dercum, M.D.

Porta, Giovanni Battista. Physiognomoniae coelestis libri sex. Lugduni Batav., apud Hieronymum de Vogel, 1645.

Engraved title-page.

Fund for Rare Books.

Portal [Antoine]. Rapport fait par ordre de l'Académie des sciences, sur les effets des vapeurs méphitiques dans le corps de l'homme, et principlement sur la vapeur du charbon. Paris, De l'Imp. de Vincent, 1776.

Fund for Rare Books.

Relazione dell' esperienze fatte in Inghilterra, Francia, ed Italia intorno alla celebre, e famosa trasfvsione del sangve per tvtto maggio 1668.*** [da Emilio Maria Manolessi.] Bologna, Manolessi, 1668.

John D. Griscom Fund.

Retz, Noël. Précis sur les maladies épidémiques, qui sont les sources de la mortalité parmi les gens de guerre, les gens de mer et les artisans.*** Paris, Méquignon, 1787.

Douglas Stockton Warren Memorial Fund.

Rhodiginus, Jodonicus Caelius. Antiquarum lectionum commentarios. [Paris] ab Iodoco Badio Ascensio & Ioanne Paruo, 1517.

Engraved title-page.

Henrietta Rush Fales Baker Fund.

Riverius, Lazarus. Practice of physick in seventeen several books. Wherein is plainly set forth the nature, cause, differences, and several sorts of signs, together with the cure of all diseases in the body. By Nicholas Culpeper, Abdiah Cole and William Rowland.*** London, Sawbridge, 1668.

Presented by Frank Woodbury, M.D.

Rolevinck, Werner. Dissertationes anatomicae methodo syntheticâ exaratae.*** Noribergae, Endterus, 1656.

Fund for Rare Books.

Salernum, School of. Medicina salernitana id est conservandae bonae valetudinis praecepta. [Genevae] Stoer, 1591.

Lewis Rodman Fund.

Scharffius, Benjamin. *Τοξικολογια*, seu tractatus physico-medico-chymicus de natura venenorum in genere, in quo venenorum vires ac qualitates considerantur, ex veterum ac recentiorum opinione examinantur, et tandem ab occultis ad manifestas qualitates reducuntur. Jena, typ. Gollnerianis, 1678.

Fund for Rare Books.

Schenck, Joannes Georgius. Exotericorum experimentorum ad varios morbos. Centuriae VII. Francofurti, tip. Ioannis Spiessij, 1607.

Fund for Rare Books.

Stisser, Joh. Andreas. Actorum laboratorii chemici in academia Julia editorum specimen primum, medico-chemica nec non physico-mechanica observata quaedam rariora exhibens. Helmestadi, Hammii, 1690.

Engraved title-page.

Caspar Wistar Fund.

Suetonius Tranquillus, Caius. [De XII Caesarum vitis libri XII] cum Philippi Beroaldi et Marci Antonii Sabellici commentariis.*** 6 Ed. [Venetiis, Iohannes Rubeus Vercellensis] 1506.

Fund for Rare Books.

Susio, Giovanni Battista. Libro del conoscere la pestilenza. Doue si mostra, che in Mantoua non è stato male di simil sorte l'anno M.D. LXXV. nè s'è ragioneuolmente potuto predire, che ui debba essere la seguente primauera. Mantuova, Ruffinello, 1576.

Horace Magee Memorial Fund.

Tachenius, Otto. Tractatus de morborum principe, in quo plerorumque gravium ac sonticorum, praeter naturam affectuum, dilucida enodatio, et hermetica, id est, vera et solida eorundem curatio proponitur.*** Osnabrugi, Schwänder, 1678.

Fund for Rare Books.

Taddeo Fiorentino. In C[laudii] Gal[eni] micratechnen (sic) co[m]mentarij secu[n]de editionis emaculati et ab oblivionis iniuria nuperrime vindicati studio Thome Dionysii. [Neapoli, apud A. Frizium Corinalden, 1522.]

Fund for Rare Books.

Theophilus Protospatharius. Commentaria in aphorismos Hippocratis, nunc primum e graeco in latinum sermonem conversa. Lucovico Corado Mantuano interprete. Venetiis, apud Cominum de Tridino, Montisferrati, 1549.

Horace Magee Memorial Fund.

Thoelde, Johann. Haliographia; Das ist, Gründliche vnnd eigendliche Beschreibung aller Saltz-Mineralien. [Leipzig] Apel, 1612.

Fund for Rare Books.

Thulemeierus, Conradus. De epilepsia.*** Disputatio medica inauguralis. Lugd. Batav., apud Johannes et Danielem Elsevier, 1652.

John D. Griscom Fund.

Titelmann, Franciscus. Naturalis philosophiae compendium, sive de consideratione rerum naturalium. Lib. XII. Venetiis, apud Ioann. Antonium Farreum, 1571.

Fund for Rare Books.

Tommasini, Giacomo. Quanto influisca il cuore su la circolazione del sangue. Parma, dalla reale tip. Parmense, 1794.

Fund for Rare Books.

Valverde de Hamusco, Juan. Anatomia del corpo umano composta. Nuouamente ristampata.*** Vinetia, della stamperia de Giunti, 1586.

Engraved title-page.

J. Ewing Mears Fund.

Versehung bey der Seel und Leibs des Menschen durch geistlich und leibliche Artzeyung.*** Strassburg, Knoblouch, 1518.

Fund for Rare Books.

Vesalius, Andreas. Anatomia; addita nunc postremo etiam antiquorum anatome. Venetiis, apud Ioan Anton et Iacobum de Franciscis [1604].

J. Ewing Mears Fund.

de Vigo, Joannes. Practica. Lvgdvni, apud haeredes Iacobi Iuntae, 1561.

J. Ewing Mears Fund.

Viventius, Joannes. De cicuta commentarius.*** Accedit epistola de Neapolitana epidemica febre anni MDCCLXIV. Editio tertia. Neapoli, Campo, 1774.

Fund for Rare Books.

Wilkinson, Charles Henry. Essays, physiological and philosophical, on the distortion of the spine, the motive power of animals, the fallacy of the senses, and the properties of matter. London, Low, 1798.

Presented by the Pennsylvania Hospital.

Manuscripts

Ashhurst, John, Jr. Various manuscript class books, cash books, etc.

Presented by his son, A. P. C. Ashhurst, M.D.

Marshall, Jacob. Sein Pennsylvanischen Arzt- und Kunst-Buch. Buch Geschriben im Jahr unser hernu 1807. [Reading, 1807.]

Presented by his grandson, John Marshall, M.D.

White, J. [Book of manuscript prescriptions.] [Barnsley, 1836–1852.]

[*Vellum cover with metal clasp.*]

Presented by Francis X. Dercum, M.D.

Other Interesting Additions

A photograph of the Episcopal Hospital [c. 1895]; a photograph of the Ingersoll Operating Room, Episcopal Hospital, Dr. Richard H. Harte operating [c. 1895]; a colored view of Lincoln Hospital, Washington, D. C., 1864; one pass of the U. S. A. Hospital, Germantown, signed by W. R. Dunton.

Presented by A. P. C. Ashhurst, M.D.

A photographic copy of the portrait of Casserius, taken from his work entitled "De Vocis Auditusque Organis Historia Anatomica," Ferriae, 1601.

Presented by James Moores Ball, M.D.,
through the courtesy of George E. de Schweinitz, M.D.

A photolithograph of Philippe Pinel (Friend of the Insane) in the Salpêtrière 1793.

Presented by Charles W. Burr, M.D.

A bronze medal of William Harvey (1578–1657) commemorating the "International Physiological Congress, Edinburgh, 1923."

Presented by Leon Jonas, M.D.

A photograph taken on the occasion of the bestowing of the degree of Doctor Honoris Causa of the University of Paris, November 24, 1923 when eight new doctors were honored, two in each faculty of Law, Belles Lettres, Medicine and Science.

Presented by W. W. Keen, M.D.

A silver token of Conrad Gesner, 1564; a bronze token of Richard Mead (c. 1755); a bronze token of Lavater, 1818; a bronze token of Hahnemann (c. 1790); a copper man midwife token, 1724; a copper cutting teeth token; a copper midwifery token, 1841; a copy of the bronze medallion by Dr. R. Tait McKenzie for the Mary Ellis Bell prize for "Undergraduate Medical Research," which is presented annually at the meeting of the Undergraduate Medical Association of the University of Pennsylvania.

Presented by Edward B. Krumbhaar, M.D.

A bill of the Pennsylvania Hospital for the board of Richard Wharton, dated July 31, 1800.

Presented by Miss Anna H. Wharton.

We have also received during the past year a number of interesting and more or less valuable autograph letters.

Use of the Photostat: During the past year there have been furnished to Fellows of the College 446 prints and to other than Fellows, on application, 124 prints. These outside applications include requests from Baltimore; Chicago; Glenolden, Pa.; Gustine, Calif.; Madison, Wis.; New York City; Philadelphia; and Savannah, Ga.

The work for the Library has been continued, according to the instructions of the Library Committee, as heretofore; 4,540 large and small prints have been made; 12 volumes of incunabula completed, as well as various portraits and manuscripts. Up to the present time there have been made photostat copies of 214 incunabula.

There has been no increase in the Library Endowment Funds during the past year. The entire year's income from the funds amounts to about $12,750.00. A complete list of all the funds and the expenditures for the year is given in a previous part of this Report, and it can be readily seen that the expenditures exceed the income. All additional expenses, salaries, binding and various requirements that may be needed each year have to be governed according to the funds appropriated by the College to the Library Committee annually. The item of binding is most important; while the cost has greatly advanced, doubled in fact, there has been no increase in the funds received by the Committee. In consequence only the important periodicals and books are bound, and much work, including the binding of pamphlets and reprints by subjects, has been delayed for some years.

About ten years ago the Library Committee, in their Annual Report, called the attention of the Fellows of the College to a fact that it is thought desirable to repeat at the present time: "That, although there is printed on every notice of the meetings of the College sent out a request to the Fellows for their photographs

for the College collection, the response has been, and we regret to say has continued to be, very meager." The record for the past year is five photographs of the Fellows of the College received. It should be fully understood that this request is made entirely as a matter of historical interest. There have been several applications for copies of the photographs of Fellows of the College during the past year that we were unable to supply.

An account of stock has been taken and any displacements found arranged in their proper order; no report has been made of any books missing from the shelves.

There have been three changes in the Library Staff during the past year; these all occurred in the first week in September; and in consequence, there was the additional work, accumulated during the summer vacation, to be cleaned up before the end of our current year. This has practically been completed.

The figures given in this Report of the use of the Library are interesting, in a way, as indicative of the literary activity of the medical profession of Philadelphia and its vicinity, during the past year; they have, however, as has been previously stated, no bearing whatsoever on the increase in the resources and capabilities of the Library.

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FRANCIS X. DERCUM, M.D.,
Chairman.

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